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The Third Age of Oil and Gas Law

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History's biggest oil boom is happening right now, in the United States, ushering in the third age of oil and gas law. The first age of oil and gas law also began in the United States a century ago when landowners and oil companies developed the oil and gas lease. The lease made the modern oil and gas industry possible and soon spread as the model for development around the world. In the second age of oil and gas law, landowners and nations across the globe developed new legal agreements that improved upon the lease and won these resource owners a larger share of the benefits of oil and gas production. The third age of oil and gas law, which is now beginning, will be defined by three forces. First, fracking is transforming the common law doctrines that underlie oil and gas law and policy. Second, both private and public landowners are perfecting agreements that can win them a greater share of the oil and gas under their land. Third, public landowners are beginning to seek ways to balance their efforts to extract maximum value from their oil with their efforts to limit climate change.

This Article is the first to identify these ages of oil and gas law, which have been central to the development of law, the global economy, and the modern world. It also reveals the legal and economic logic of agreements between oil and gas companies and public and private landowners, and how they have evolved over the past century. And it describes how landowners could ensure maximum benefit from the unprecedented oil boom now transforming global oil production.

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INTRODUCTION

Oil is the lifeblood of the global economy.[1] The internal combustion engine forever changed global transport, trade, and war—rendering every car, ship, armored vehicle, and plane dependent on oil supplies.[2] For the last century, the price of oil has determined whether the world economy boomed or stagnated, and oil reserves have often determined how the world's wealth is distributed.[3] Over these same years, access to oil has been the cause of conflicts and often determined these conflicts' fates.[4] The history of oil tells much of the history of the modern world: the rise of the United States as a global superpower, the defeat of the Axis powers in World War

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1. Donald H. Ford, *Controlling the Production of Oil*, 30 MICH. L. REV. 1170, 1170 n.1 (1932) ("Save the products of agriculture, the products of oil are the most essential to the processes and requirements of our present civilization.").

2. John C. Jacobs, *Unit Operation of Oil and Gas Fields*, 57 YALE L.J. 1207, 1207 (1948) (quoting Hail v. Reed, 54 Ky. (15 B. Mon.) 479, 490 (Ky. 1854)) ("In less than a century, petroleum has changed from 'a peculiar liquid not necessary nor indeed suitable for the common use of man' to a substance indispensable to the military security and economic prosperity of a modern nation.").

3. Rex G. Baker & Erwin N. Griswold, *Percentage Depletion – A Correspondence*, 64 HARV. L. REV. 361, 362 (1951) ("Both in peace and in war the country must have and is very dependent upon oil and gas. Our civilian economy and the national safety would be jeopardized if we failed to maintain adequate reserves of petroleum."); James D. Hamilton, *Historical Oil Shocks* 26 (Nat'l Bureau of Econ. Research, Working Paper No. 16790, 2011) (since World War II all but one U.S. recession was preceded by a spike in oil prices).

4. *See* Wm. E. Colby, *The Law of Oil and Gas: With Special Reference to the Public Domain and Conservation*, 30 CALIF. L. REV. 245, 245 (1942) ("Without petroleum modern warfare would be impotent and hence we have the life and death struggles which are now going on in the world to reach and control the sources of supply.").

II, the wave of multinational investment in the developing world followed by nationalizations, and the birth of an increasingly multi-polar world order.[5]

Likewise, this Article shows that the history of oil and gas law tells much of the story of legal development over the past century: the foundational role of the common law, and property law in particular, increasingly supplemented and supplanted by statutes and regulations, and a growing judicial willingness to enforce sophisticated contracts and defer to regulations written by expert agencies. Oil and gas law has also been a crucible for key trends in international law: new emphasis on choice of law, growing reliance on arbitration to settle disputes with sovereigns, and increasingly complex and finely articulated contracts and treaties to set out the duties between companies and sovereign nations. This Article unearths these histories and defines these two ages of oil and gas law that have built the modern legal world. It shows that we are now entering a third age of oil and gas law, which will be defined by the legal challenges posed by fracking and climate change. And it shows how landowners can ensure that they receive the full benefit of this decade's oil boom—the biggest that the world has ever seen.

Part I describes the first age of oil and gas law, which was born in the United States at the dawn of the twentieth century. It was driven by new oil supply in Texas and new demand for oil from motor vehicles around the world. The three key legal developments of the first age of oil and gas law were the rule of capture, the lease, and the leases' analogue for nations—the concession. All three were designed to encourage rapid oil extraction. The rule of capture is the principle that a landowner owns all the oil that can be extracted from her land, even if it comes from a reservoir shared with a neighbor. The lease is the way that landowners benefit from these resources: rather than selling their land outright, landowners trust an oil and gas company to develop it in return for a share of oil and gas production. In these early days, developing nations often gave oil companies concessions for oil development that mirrored the early leases signed by private landowners in the United States. In fact, in the first half of the century, savvy U.S. landowners often leased under better terms than the sovereigns that gave oil companies concessions covering vast tracts of land in the Middle East that are now synonymous with oil production.

Part II describes the second age of oil and gas law, which began when the global powers realized that oil was both finite and key to their future economic and military might. It saw a transition from the United States as the uncontested center of world oil production to a new center of power in the Middle East. It shifted focus from rapid oil production to maximizing the long-term value of production. States placed increasing limits on the rule of capture—limiting how many wells could be drilled and how fast oil could be pumped, and pushing owners to develop oil and gas reservoirs efficiently, with maximum production at minimum cost. And public landowners in the developing world, increasingly independent from the old Western powers, renegotiated or nationalized their old concessions, catching up with and then surpassing private landowners in the sophistication of their contractual arrangements with oil and gas companies.

Part III describes the third age of oil and gas law, which is just beginning. Directional drilling and hydraulic fracturing, or "fracking," has unlocked the largest

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5. *See infra* Parts II, III.

oil boom the world has ever seen. It quickly made the United States the world's largest producer of petroleum. Then, as the boom accelerated in 2018, the United States increased its oil production faster than any country has ever done. As a result, for the first time, countries around the world are realizing that climate regulation may limit oil consumption long before dwindling oil supply does. This new age of oil and gas law will be defined by fracking; increased climate regulation; and sophisticated private, public, and institutional landowners. Fracking has in some ways limited the traditional problems of production from common reservoirs while simultaneously creating new complications for the rule of capture. At the same time, public landowners are learning how to balance the traditional imperative of encouraging production with new efforts to cut greenhouse gas emissions. Finally, public and private landowners are perfecting the structure of oil and gas agreements with oil companies; this Article describes further steps they could take to ensure maximum benefit from the new oil and gas boom.

I. THE FIRST AGE OF OIL AND GAS LAW

The first age of oil and gas law began ten days into the twentieth century, when the Spindletop gusher blew out in Beaumont, Texas, on January 10, 1901.[6] The Beaumont boom was not the world's first oil boom; there had been nineteenth-century oil booms in Pennsylvania and in Baku, now part of Azerbaijan but then part of the Russian Empire.[7] But the Beaumont boom changed the world. Most importantly, it coincided with the development of the automobile and the internal combustion engine, which created a seemingly unending demand for petroleum products.[8] And it also cemented the United States as the world center of the oil industry, as the world's leading industrial power, and the world's leading producer of oil for the next sixty years.[9]

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6. *See* BERNARD F. CLARK, JR., OIL CAPITAL: THE HISTORY OF AMERICAN OIL, WILDCATTERS, INDEPENDENTS AND THEIR BANKERS 52–54 (2016); DANIEL YERGIN, THE PRIZE: THE EPIC QUEST FOR OIL, MONEY AND POWER 66–76 (3d ed. 2012); Alexandra B. Klass & Danielle Meinhardt, *Transporting Oil and Gas: U.S. Infrastructure Challenges*, 100 IOWA L. REV. 947, 959 (2015).

7. *See* YERGIN, *supra* note 6, at 3–15, 41–43. Some of the earliest oil wells were drilled accidentally by prospectors trying to produce salt. CHARLES AUSTIN WHITESHOT, THE OIL-WELL DRILLER: A HISTORY OF THE WORLD'S GREATEST ENTERPRISE, THE OIL INDUSTRY 22–24 (1905).

8. The previous oil booms had focused on producing kerosene, a cheap substitute for more valuable whale oil. *See* RICHARD RHODES, ENERGY: A HUMAN HISTORY 138–44 (2018); PETER TERTZAKIAN, A THOUSAND BARRELS A SECOND: THE COMING OIL BREAK POINT AND THE CHALLENGES FACING AN ENERGY DEPENDENT WORLD 19–20 (2007) (describing how "kerosene became the most sought-after illuminant on the market" because most consumers could not afford sperm whale oil anymore); HAROLD F. WILLIAMSON & ARNOLD R. DAUM, THE AMERICAN PETROLEUM INDUSTRY: THE AGE OF ILLUMINATION 1859–99, at 232–51 (1959); *cf*. HERMAN MELVILLE, MOBY DICK 478 (Penguin Books 1988) (1851) (describing how when whalers illumined their modest ships with their precious oil "you would have almost thought you were standing in some illumined shrine of canonised kings and counsellors").

9. By 1928, "the United States produced 68% of the world's total." J. Howard Marshall & Norman L. Meyers, *Legal Planning of Petroleum Production*, 41 YALE L.J. 33, 33 n.2

The three key developments of the first age of oil and gas law were the rule of capture; the lease for private landowners; and its analogue for state owners of oil and gas, the concession. These public and private legal rules each were designed to encourage rapid oil production. The rule of capture meant that quick drilling could gain landowners an outsized share of the oil trapped in reservoirs beneath shared land. And the lease and concession offered resource owners a share of oil production from their lands, giving the landowner an interest in rapid and robust production.

A. The Rule of Capture

The first age established the rule of capture—the principle that a landowner owns all the oil that can be extracted from his or her land.[10] In the United States, landowners own the minerals beneath their property.[11] This principle is anachronistically known as the *ad coelum* principle,[12] which literally means, "to the heavens."[13] It is taken from the Latin phrase *ad coelum et ad inferos*—meaning that a landowner owns from the heavens above, *coelum*, to hell below, *inferos*.[14] So in the United States, the gold, silver, or coal in the earth generally belongs to the owner of the surface above.[15] In the rest of the world, the minerals in the earth generally belong to the state, not individual landowners.[16]

(1931) (citing U.S. BUREAU OF MINES, WORLD'S PRODUCTION OF CRUDE PETROLEUM IN 1930, ANNUAL PETROLEUM STATES 75a (1930)). By 1932, the United States still "produce[d] 62% of the total supply of the world." Ford, *supra* note 1.

10. *See* Kelly v. Ohio Oil Co., 49 N.E. 399, 401 (Ohio 1897) (noting that oil pumped from a landowner's well "belongs to the owner or lessee of the land" because "no one can tell to a certainty from whence the oil, gas, or water which enters the well came" so the "right to drill and produce oil on one's own land is absolute and cannot be supervised or controlled by a court or an adjoining landowner").

11. Monika U. Ehrman, *One Oil and Gas Right to Rule Them All*, 55 HOUS. L. REV. 1063, 1064–65 (2018).

12. JOHN S. LOWE, OIL AND GAS LAW 54 (6th ed. 2013).

13. Lora D. Lashbrook, *The "Ad Coelum" Maxim as Applied to Aviation Law*, 21 NOTRE DAME L. REV. 143, 143 n.1 (1946) (citing BLACK'S LAW DICTIONARY (3d ed. 1933)).

14. CLARK, *supra* note 6, at 10; LOWE, *supra* note 12.

15. Del Monte Mining & Milling Co. v. Last Chance Mining & Milling Co., 171 U.S. 55, 60 (1898) ("The general rule of the common law was that whoever had the fee of the soil owned all below the surface, and this common law is the general law of the States and Territories of the United States . . . ."); CLARK, *supra* note 6, at 7 ("In spite of the patchwork provenance of lands that came to form the U.S., the private landowner has owned both the surface and all minerals beneath his land in every state in the union."). This is the default rule: landowners can sell the minerals below their land. *See infra* notes 52–53 and accompanying text.

16. *See, e.g.*, CLARK, *supra* note 6, at 12 ("By the end of World War I, the strategic and economic potential of oil was recognized and nations that permitted private mineral ownership nationalized their hydrocarbon resources."). Some nations, such as Canada, provide for private ownership of minerals in some circumstances. *See, e.g.*, Orphan Well Ass'n v. Grant Thornton Ltd., [2019] S.C.R. 5, para. 11 (Can.) (Supreme Court of Canada adopting Stewart's private theory of property ownership of oil and gas resources in Canada); Fenner L. Stewart, *How to Deal with a Fickle Friend? Alberta's Troubles with the Doctrine of Federal Paramountcy*, *in* ANNUAL REVIEW OF INSOLVENCY LAW 2017 163, 204 (Janis P. Sarra & Barbara Romaine, eds.)

Oil and gas is governed by the rule of capture.[17] This rule somewhat modifies the *ad coelum* rule: it says that a landowner owns all the oil and gas that can be *extracted from* his or her land.[18] Oil and gas is fluid, so when a landowner pumps oil and gas from her land, it often draws oil and gas from under her neighbor's land.[19] As a result, a landowner does not own all the oil under her land as securely as she owns the coal under her land: if her neighbor pumps the oil out from a shared reservoir under her land, it belongs to the neighbor.[20] Thus, landowners own the oil and gas under their land subject to the rule of capture. Conversely, the rule of capture means that a landowner may own more oil than was originally under her land: if she pumps oil from a shared reservoir, she owns that oil even if it came from under a neighbor's land.[21]

Why did American courts establish the rule of capture? The main benefit of the rule of capture is that it makes it unnecessary to determine where the oil pumped out of the ground came from.[22] Early courts knew very little about oil reservoirs or how oil traveled under the earth.[23] Courts knew it sometimes bubbled out of the earth and could be pumped out; they knew that, eventually, no more oil could be pumped.[24]

(detailing the differences between the legal recognitions of private oil and gas ownership in Canada and the United States).

17. Bruce M. Kramer & Owen L. Anderson, *The Rule of Capture—An Oil and Gas Perspective*, 35 ENVTL. L. 899, 899 (2005) ("The rule of capture has been an integral part of oil and gas law since the completion of the first commercial oil well in Pennsylvania in the 1840s."); Karen Bradshaw Schulz & Dean Lueck, *Contracting for Control of Landscape-Level Resources*, 100 IOWA L. REV. 2507, 2526 (2015) (citing BRUCE M. KRAMER & PATRICK H. MARTIN, THE LAW OF POOLING AND UNITIZATION § 2.01 (3d ed. 2013)) ("[T]he 'rule of capture' doctrine . . . emerged in all oil–gas states.").

18. Robert E. Hardwicke, *The Rule of Capture and Its Implications as Applied to Oil and Gas*, 13 TEX. L. REV. 391, 393 (1935) (explaining that the owner of the well may keep this oil without compensating the neighbor because "[t]he owner of a tract of land acquires title to the oil or gas which he produces from the wells drilled thereon, though it may be proved that part of such oil or gas migrated from adjoining lands").

19. CLARK, *supra* note 6, at 57 ("The fugacious nature of oil and gas and the permeable nature of the oil-bearing formation underground allow oil to flow without regard to surface-property boundaries, resulting in that a property owner can be producing his neighbor's oil and gas as well as his own."); Jacobs, *supra* note 2.

20. Hardwicke, *supra* note 18; *see also* Yael R. Lifshitz, *Rethinking Original Ownership*, 66 U. TORONTO L.J. 513, 525–26 (2016).

21. Hardwicke, *supra* note 18 ("The owner of a tract of land acquires title to the oil and gas which he produces from wells drilled thereon, though it may be proved that part of such oil or gas migrated from adjoining lands.").

22. *Id.* at 397 ("It is quite clear that the rule of capture was based on an admitted inability to determine with reasonable accuracy the source of production from any well.").

23. Courts speculated that oil under the ground was "wild and will run away," Barnard v. Monongahela Nat. Gas Co., 65 A. 801, 802 (Pa. 1907), and that it could "percolate restlessly about under the surface of the earth, even as the birds fly from field to field and the beasts roam from forest to forest," Medina Oil Dev. Co. v. Murphy, 233 S.W. 333, 395 (Tex. App. 1921), *cited in* CLARK, *supra* note 6, at 58. For an alternate view that courts were, or at least should have been, better informed on the working of oil and gas reservoirs see TERENCE DAINTITH, FINDERS KEEPERS? 18–50 (2010).

24. *See* Ford, *supra* note 1, at 1172–73 (describing misconceptions about the nature of oil

But they did not know where the oil had come from—perhaps the oil came from under many neighbors' lands.[25] If they had strictly followed the *ad coelum* doctrine, judges would have had to divide the oil pumped from a surface well among all the landowners whose subsurface may have once held the oil.[26] Instead, the judges adopted the simple rule of capture: if the oil is pumped out of a well on your land, it is your oil.[27]

The rule of capture has many other benefits and costs. One benefit is that it encourages production of oil. If the rule of capture applies, then as soon as your neighbor begins drilling for oil, you are experiencing what could be called an "oil and gas emergency." If the neighbor completes the well and begins pumping oil, she will likely begin to pump oil from a shared reservoir beneath your land.[28] Your sole remedy is to begin drilling yourself—that is the only way to ensure that you get your fair share of the common oil reservoir that likely underlies your two properties.[29] And all of your other neighbors face the same logic.[30] So the rule of capture encourages rapid development: a race to produce oil.[31]

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and gas reservoirs); Note, *The Ownership of Natural Gas and Some Real Property Concepts*, 36 VA. L. REV. 947, 949 (1950).

25. *See* Hardwicke, *supra* note 18, at 394 ("Neither a barrel of oil nor a cubic foot of gas has any characteristics, by reason of its previous existence under any particular tract of land, which clearly distinguish it from oil or gas produced from wells on the adjoining tracts."); *see also* David E. Pierce, *Minimizing the Environmental Impact of Oil and Gas Development by Maximizing Production Conservation*, 85 N.D. L. REV. 759, 760 (2009) ("The 'rule of capture' was initially a rule of necessity that quickly became the foundational principle for defining rights in oil and gas.").

26. *See* CLARK, *supra* note 6, at 60 ("The rule of capture was not so much a 'right to capture,' but more of an absolute defense to liability for draining the adjoining owners' reserves."); Hardwicke, *supra* note 18, at 394 (explaining that oil cannot "be earmarked or branded as are cattle so that one may readily identify such oil or gas as having originally been in place as a part of a particular tract").

27. Hardwicke, *supra* note 18, at 394. Note that this rule does not allow drilling into a neighbor's subsurface. That is called "slant drilling" and the courts consistently forbid it. LOWE, *supra* note 12, at 67.

28. *See* CLARK, *supra* note 6, at 57.

29. Northcutt Ely, *Legal History of Conservation of Oil and Gas. A Symposium*, 53 HARV. L. REV. 1070, 1071 (1940) (reviewing *Legal History of Conservation of Oil and Gas: A Symposium* (1938)) (under the rule of capture "an adjoining landowner's only remedy was to 'go and do likewise'").

30. YERGIN, *supra* note 6, at 220–23 ("Because of the rule, every operator everywhere in the United States put down his wells and produced as rapidly as he could, draining not only the oil under his own property but also that under his neighbor's property, before his neighbor drained his own.").

31. PETROLEUM CONSERVATION 249 (1951) ("If oil and gas underlay his property they would escape to his neighbor unless he reduced them to possession beforehand by drilling wells on his own property. Self-protection forced each owner of a tract of ground overlying an oil pool to drill quickly as many wells as he could and to produce each well at its utmost capacity."). It does not, however, authorize negligence that damages the reservoir shared by the neighbors, which would create liability to the neighbor that could otherwise have produced the oil. Elliff v. Texon Drilling Co., 210 S.W.2d 558, 563 (Tex. 1948). Such negligence violates what are known as the neighbors' correlative rights. *Elliff*, 210 S.W.2d, at 562.

This imperative to produce also comes with several downsides: a race to produce creates waste.[32] First, it leaves oil in the ground. You can never extract all the oil in an underground reservoir, but efficient extraction can produce many times more oil than a haphazard approach.[33] The oil is under pressure underground that helps it rise to the surface; if you steadily pump it out with the right number of wells, you maximize recovery.[34] If you puncture the reservoir with too many wells, reservoir pressure drops and you will not be able to extract as much oil.[35] And if you pump too fast, too much water may become mixed into the oil.[36] This water weighs down the lighter oil, making it harder to pump, and the water is expensive to separate and dispose of because it often contains dangerous chemicals[37]—if too much water is mixed in the oil it may no longer be worth producing.[38] So too many wells or extracting too quickly can mean producing less oil overall.

Venice Beach, California, 1931. *Source:* USC Libraries.

Second, a race to produce may mean that society spends far more than necessary on oil wells.[39] Why should each

32. CLARK, *supra* note 6, at 55–62.

33. Northcutt Ely, *The Conservation of Oil*, 51 HARV. L. REV. 1209, 1220 (1938); *see* LOWE, *supra* note 12, at 44 ("About 3/4th of all the oil discovered still remains where it was found."). Careful reservoir management can mean the difference between recovering less than ten percent of the oil in place and upwards of fifty percent. *Id.* at 22–23.

34. Ely, *supra* note 29 ("In the older pools, 90 per cent of the original oil content was left underground; in the finest ones, perhaps 25 per cent.").

35. YERGIN, *supra* note 6, at 222 ("To dissipate gas through helter-skelter production was to lose that essential pressure, and thus to leave large amounts of petroleum unrecovered underground."); Howard R. Williams, *Conservation of Oil and Gas*, 65 HARV. L. REV. 1155, 1159 (1952) (overdrilling caused "dissipation of native reservoir energy").

36. LOWE, *supra* note 12, at 23 ("uncontrolled" pumping causes "reservoir water [to] 'channel' and begin to be produced alongside . . . the oil and gas").

37. Branch v. W. Petroleum, Inc., 657 P.2d 267, 270 (Utah 1982) (describing expense of disposing this water which contains "oil, gas and high concentrations of salt and chemicals").

38. *See* Note, *Administrative Regulation of Petroleum Production*, 59 HARV. L. REV. 1142, 1142 (1946) ("Poor production methods and excessive production rates, through dissipation of reservoir energy and drowning of oil strata by water encroachment, result in leaving a large percentage of oil inert in the ground with recovery possible only at prohibitive cost.").

39. LOWE, *supra* note 12, at 615 ("There was a tendency to deplete each pool as fast as it was physically possible for the well to produce the oil. Drilling was continued until the declining production of old wells indicated that a new well would not recover its cost. This resulted in a very close spacing of wells in rich pools and wider spacing in pools of lower

neighbor drill her own expensive oil well when all the oil in the reservoir could be extracted with just two or three wells?[40] By encouraging more wells, the rule of capture encourages inefficient spending on drilling duplicative and unnecessary oil wells.[41]

Third, these extra wells are unsightly and damage the environment.[42] Each new well is an eyesore—creating an "iron orchard" spreading across the land.[43] Each time a well drills through the water table it creates a chance of contaminating water supplies.[44] Every new well could cause a blowout that would lead to wasted oil spilling across the property's surface.[45]

Finally, from the perspective of a dominant oil producer, such as the United States and Texas were in the 1930s, overproduction created another problem: low prices.[46] A normal producer must simply try to survive periods of low prices.[47] But a dominant producer sometimes can actually increase profits by selling less, because offering less product for sale raises prices so much that the producer earns more overall even

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yield. The density of drilling bore no relation to the number of wells actually required to recover the oil, and tremendous waste in the form of unnecessary development costs resulted.").

40. Williams, *supra* note 35, at 1164 (arguing that the rule of capture "results in uneconomic use of materials and labor in the drilling of unnecessary wells").

41. *See* Hardwicke, *supra* note 18, at 419 ("[I]f one well would efficiently and economically drain ten acres, the drilling of two wells should not be required . . . .").

42. *See* Williams, *supra* note 35, at 1164.

43. TOM PENDLETON, THE IRON ORCHARD (1966); *see* Harold Hotelling, *The Economics of Exhaustible Resources*, 39 J. POL. ECON. 137, 144 (1931) ("Consequently great forests of tall derricks rise overnight at a cost of $50,000 or more each; whereas a much smaller number and a slower exploitation would be more economic.").

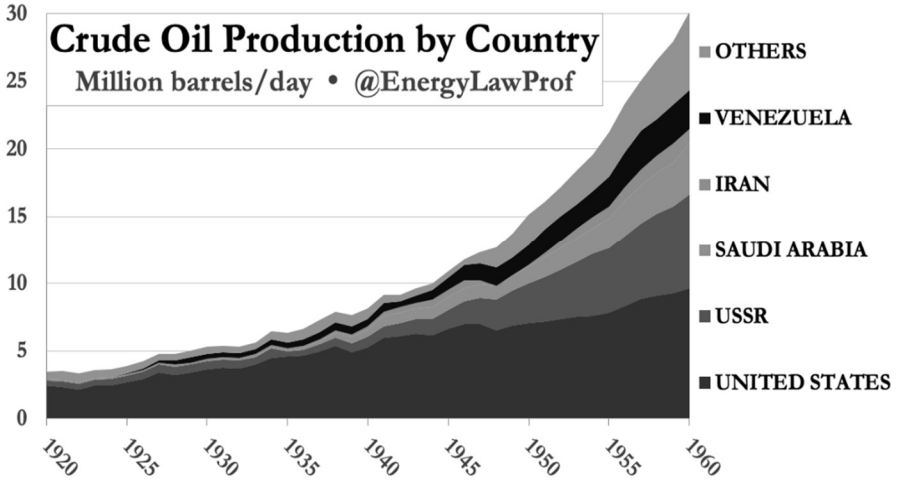
44. Caroline Cecot, *Regulatory Fracture Plugging: Managing Risks to Water from Shale Development*, 6 TEX. A&M L. REV. 29, 39–40, 39 fig.2 (2018) (categorizing risks to water from oil and gas production, including drilling); Lauren A. Patterson et al., *Unconventional Oil and Gas Spills: Risks, Mitigation Priorities, and State Reporting Requirements*, 51 ENVTL. SCI. & TECH. 2563, 2569 (2017).

45. *See* YERGIN, *supra* note 6, at 82 (describing Spindletop blowout).

46. CLARK, *supra* note 6, at 71–88; Marshall & Meyers, *supra* note 9, at 33 (1931).

47. *See* J. Howard Marshall & Norman L. Meyers, *Legal Planning of Petroleum Production: Two Years of Proration*, 42 YALE L.J. 702, 736–40 (1933) (describing why a single state cannot benefit by cutting production but a coalition of states can).

though it is selling less oil.[48] During the 1930s, the United States alone produced over half of the world's oil, and Texas often produced nearly half of U.S. oil—a more dominant role than any state or nation has had since that time.[49] As dominant



producers, the United States and Texas could have increased their profits by slowing their race for oil production.

B. The Oil and Gas Lease

The oil and gas lease is the most common agreement that landowners make with an oil and gas company to profit from the hydrocarbons under their land.[50] To see

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48. Of course, a normal producer cannot do this—if it cut its production in the hope of generating higher prices, other producers would just take its place. And if its reduction had any effect on the much broader oil market, that would only benefit the other producers that took its place. The ability to raise profits by cutting production—to control such a large share of the market that when you cut production, prices rise more than enough to compensate for selling fewer units—is the definition of market power. E.V. Rostow & A.S. Sachs, *Entry into the Oil Refining Business: Vertical Integration Re-Examined*, 61 YALE L.J. 856, 905 (1952).

49. DAVID F. PRINDLE, PETROLEUM POLITICS AND THE TEXAS RAILROAD COMMISSION 4, 71 (1981) (Texas production reached 45% of U.S. production by 1953); Ford, *supra* note 1; James D. Hamilton, *Historical Oil Shocks* 8 (Nat'l Bureau of Econ. Research, Working Paper No. 16790, 2011) ("Texas . . . accounted for 40% of the crude petroleum produced in the United States between 1935 and 1960."). Today, the world's biggest oil producers—Saudi Arabia, the United States, and Russia—each only produce about twelve percent of the world's oil. U.S. Energy Info. Admin., *The United States Is Now the Largest Global Crude Oil Producer*, EIA: TODAY IN ENERGY (Sept. 12, 2018), https://www.eia.gov/todayinenergy/detail.php?id=37053 [https://perma.cc/J4VK-G8Z8].

50. *See* David E. Pierce, *Rethinking the Oil and Gas Lease*, 22 TULSA L.J. 445, 445–48 (1987) ("The framework for [the lease] was established shortly after the turn of the century and has remained unchanged since that time."); Ernest E. Smith & John S. Dzienkowski, *A Fifty-Year Perspective on World Petroleum Arrangements*, 24 TEX. INT'L L.J. 13, 18–19 (1989); A. W. Walker, Jr., *Nature of the Property Interests Created by an Oil and Gas Lease in Texas*, 7 TEX. L. REV. 1, 12–13 (1928); A. W. Walker, Jr., *Nature of the Property Interests*

why landowners usually lease, rather than sell, their land to an oil and gas company, take the perspective of the landowner. If you are lucky enough to have oil under your land, it could be worth a lot of money. But how much? And how do you get this money?

The most straightforward solution would be to extract it yourself. But landowners almost never have the capital or know-how to extract oil from their own land—not to mention the equipment, technology, time, or work force.[51] So you will have to bring in an oil company to extract your oil. How do you get this company to pay you what your oil is worth?

The simplest way to get money from an oil company would be to sell the company the oil under your land.[52] Property law allows you to sell the oil under your land to an oil company and keep the surface for yourself—this is known as a "severance" of the "mineral interest" because it severs the interest in the oil and gas minerals beneath the surface from the rest of the landowner's interest in the land.[53] In theory, a landowner willing to sell her mineral interest could ask an oil company to pay the full value of the oil under her land, minus the cost of extraction, minus a reasonable profit for the company.[54] As a simplified example, imagine that a landowner named Laura knows that there are one million barrels of accessible oil under her land and oil is worth $66 per barrel, so an oil company could take away $66 million of oil from her land. Imagine an oil company named Ovid Oil Company believes that it would have to pay $40 million to drill and operate wells to extract this oil.[55] And imagine Ovid wants a 10% profit on its oil investments.[56] In this simplified example,

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Created by an Oil and Gas Lease in Texas, 7 TEX. L. REV. 539, 539–40 (1929).

51. Note, *Recent Trends in Oil and Gas Conservation Statutes*, 25 VA. L. REV. 360, 361 n.6 (1938–1939) ("The majority of landowners lack sufficient capital to produce the oil themselves, and consequently almost all production is carried on by operators, acting under leases, who bear the expense of production and pay royalties to the landowners.").

52. Mark P. Gergen, *The Use of Open Terms in Contract*, 92 COLUM. L. REV. 997, 1026 (1992) (noting that the least complex arrangement for economically benefiting from one's oil and gas would be to simply sell it).

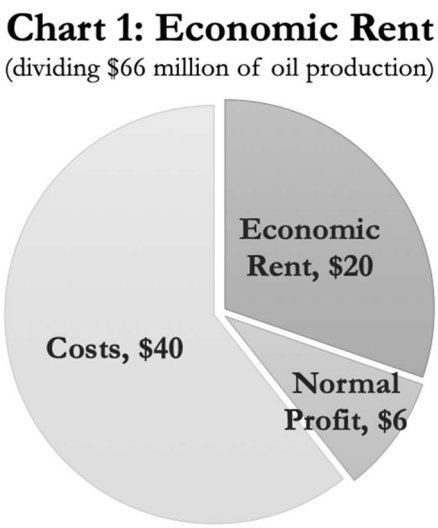
53. A. W. Walker, Jr., *Fee Simple Ownership of Oil and Gas in Texas*, 6 TEX. L. REV. 125, 128 (1928) ("The landowner, however, may sever his estate in the oil and gas from his estate in the remainder of the realty either by granting away his estate in the oil and gas or by conveying his estate in the surface realty and reserving or excepting his estate in the oil and gas."). States differ on whether this severance grants a right to the oil in place or simply an exclusive right to extract oil from the land, Lanre Aladeitan, *Ownership and Control of Oil, Gas, and Mineral Resources in Nigeria: Between Legality and Legitimacy*, 38 T. MARSHALL L. REV. 159, 161–68 (2013), but the important point is that, after this severance, all oil pumped from wells on the land will belong to the oil company, not to the landowner.

54. The surplus value of a resource after subtracting the cost of extraction and the normal rate of profit is known as its "economic rent." PAUL SAMUELSON, ECONOMICS 526–28 (11th ed. 1990).

55. So the net profit from the well, that the landowner and company must divvy up, would be $26 million: $66 million minus the $40 million cost of extraction. Note that this simplified example lumps together all the complex costs that go into drilling and operating a well such as equipment, employees, taxes, and permit fees. For simplicity, it also ignores the time discount of money—the reality that a dollar in a year is worth less than a dollar today.

56. Ovid would insist on a profit on its investment because there are always other

Laura could ask the company to pay her $20 million for her oil: when Ovid extracted the $66 million in oil, it would get its $40 million in investment back and the $20 million it paid Laura, plus its normal 10% profit—$6 million in this case, and Laura would keep the rest. If Laura charged $20 million for her oil, an economist would say she had extracted all the "rent" from her oil—rent is the value of a resource after subtracting the cost to extract it and the usual rate of return that a company can demand in a competitive market.[57]



In theory, someone who owns oil in the ground would like to give the oil company only a normal profit and extract all the rent from the resource.[58] In practice, however, an oil company would never give Laura $20 million up front in the example situation above. There are simply too many uncertainties in the calculus that results in the company's $6 million profit: there could be less oil than estimated, it might be more expensive to drill and operate the wells, the price of oil might fall.[59] Keep in mind that Ovid Oil Company would have to come up with money up front to both drill and operate the well and pay Laura—$20 million for Laura and $40 million for the well—so Ovid would have to come up with $60 million in ready cash. It would simply be too risky to pay such a giant sum immediately for a stream of revenue that would eventually, even if everything goes to plan, provide only the usual 10% rate of return.[60] Oil and gas companies work very hard to raise money to operate, and there are less risky ways for an oil company to spend its money.[61]

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opportunities to invest money at a profit. In reality, its demand for profit on any particular investment would depend on the other opportunities available for investing its money.

57. SAMUELSON, *supra* note 54.

58. *See* Arlon R. Tussing, *An Economic Overview of Resource Disposition Systems*, *in* PUBLIC DISPOSITION OF NATURAL RESOURCES 19, 21–22 (Nigel Bankes & J. Owen Saunders eds., 1983) (explaining that resource owners should seek to lure investors with "*hopes* of capturing some portion of the potential economic rent in the form of above-market rates or return to investment" but "limit the rent *actually* appropriated by operators to the minimum required to keep those hopes alive") (emphasis in original); *see also* W.H. Ellis, Comment, PUBLIC DISPOSITION OF NATURAL RESOURCES, *supra*, at 42–43 (discussing U.S. and Canadian governments' methods for capturing rent from oil and gas sales).

59. *See* Baker & Griswold, *supra* note 3, at 372 (describing why the risks of oil production require a greater return than the typical investment).

60. What if the landowner offered the oil company the land for $12 million, so that the oil company would expect to earn $8 million, a 20% profit on its $40 million investment? Most oil companies would still be wary of such an investment: why pay all the money up front when an oil and gas lease allows the parties to share the risk of a bad well?

61. For example, the oil company could spread its money across multiple leases, which

Note that a straight sale would also be risky for Laura, the landowner. There might be more oil than expected, or oil prices might go up and make the accessible oil on the land worth far more than $66 million. Or new technologies might make it cheaper to drill for oil, so Ovid might spend much less than $40 million to extract the oil. And very profitable wells would be particularly unfortunate for Laura if she had simply sold her full mineral interest: not only would she miss out on the economic upside of these wells, she would have to deal with constant surface disruption from Ovid Oil Company busily working its wells to harvest its bonanza of oil production.[62] So a simple sale of oil and gas mineral rights is risky for both the landowner and the oil and gas company: the landowner worries about selling a good well for too little and the company worries about buying a bad well for too much.[63]

The solution to this problem is the oil and gas lease. Rather than paying money to the landowner up front, the lease spreads the risk of a good well or a bad well between the oil company and the landowner by paying the landowner a percentage of the oil company's production.[64] This percentage of production is called a *royalty*.[65] In the first half century of oil production, oil companies typically offered a standard royalty of 1/8 of production: 12.5%.[66] If an oil well produced $100,000 in oil, the landowner

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allows the company to share its risks with landowners. *See infra* notes 64–77 and accompanying text.

62. The surface owner's dissatisfaction could eventually be a problem for the oil and gas company that simply purchased mineral rights because the surface owner, seeing no benefit from production, might try to find ways to openly or covertly limit production. *See* Pierce, *supra* note 50, at 474 (noting that a sale of the minerals can lead to "time-consuming . . . [s]urface use disputes"). For a general description of how disputes between minerals and surface owners can be managed through public and private governance, see Tara Righetti, *Contracting for Sustainable Surface Management,* 71 ARK. L. REV. 367 (2018).

63. Oil and gas is an inherently high-risk business. For example, over the fifteen-year period from 1944–58, the rate of "successful" wells hovered around 19.7%. Charles O. Galvin, *The "Ought" and "Is" of Oil-and-Gas Taxation*, 73 HARV. L. REV. 1441, 1444 n.5 (1960).

64. This structure mitigates the "market for lemons" problem, which is that the landowner's willingness to sell might suggest that the resource is worth less than a buyer is willing to pay, unraveling any deal. *See* George A. Akerlof, *The Market for "Lemons": Quality Uncertainty and the Market Mechanism*, *in* UNCERTAINTY IN ECONOMICS 235 (Peter Diamond & Michael Rothschild eds., 1978). By retaining a share of future production, the landowner signals her belief that she is selling a share of valuable mineral rights. *See* Yoram Barzel, *Measurement Cost and the Organization of Markets*, 25 J.L. & ECON. 27, 34–35 (1982) (explaining how the same structure facilitates publishing deals); Gergen, *supra* note 52, at 1030 (explaining why this structure lowers risk for both parties, making a deal possible); Ronald J. Gilson, *Value Creation by Business Lawyers: Legal Skills and Asset Pricing*, 94 YALE L.J. 239, 262–64 (1984) (explaining how such structures enable deals even with asymmetric asset valuation); Victor P. Goldberg, *The Net Profits Puzzle*, 97 COLUM. L. REV. 524, 545–46 (1997) (explaining how the same asymmetries of information motivate profit-sharing in the movie industry).

65. Robert E. Hardwicke, Jr., *Problems Arising Out of Royalty Clauses in Oil and Gas Leases in Texas*, 29 TEX. L. REV. 790, 790–91 (1951). It is called a *royalty* because of the tradition that the monarch received a fixed percentage of production of minerals from any land. John S. Lowe, *Defining the Royalty Obligation*, 49 SMU L. REV. 223, 258 (1996) ("[T]he King retained a 'royalty' right to take gold or silver . . . .").

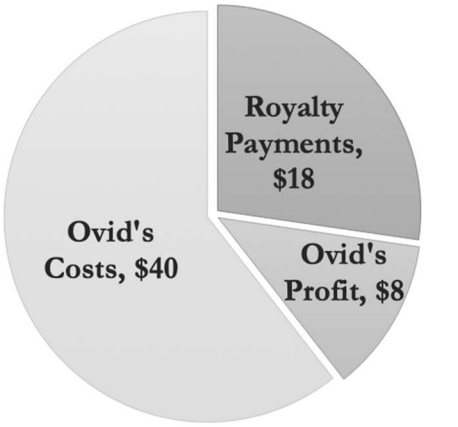
66. Gergen, *supra* note 52, at 1010 ("The lessee's primary obligation is to pay the lessor

would receive $12,500 in oil.[67] As the wells produced more oil, the landowner would receive more money. If the wells dried up, the oil company would no longer have to pay anything, so the two parties share risk.[68] And the royalty gives the landowner an incentive to help (or at least not hinder) the oil company operating on her land: the more oil that is produced, the more she receives.

So how could Laura structure a lease of her oil and gas rights to Ovid Oil Company?[69] The basic economics of the transaction remain the same: Laura and Ovid both believe the company can extract about $66 million in oil if it spends about $40 million on wells, so there is about $26 million in net revenue to split up. If Laura used the traditional 1/8 royalty and everything went according to plan, she would receive $8.25 million and Ovid would get the rest: $57.75 million. Ovid would earn a profit of $17.75 million—a healthy 44% return on its $40 million investment.

As a savvy landowner, however, Laura would probably ask for a bigger royalty. She is realistic, so she would not ask Ovid to plan on a measly 10% profit, which would be $4 million—after all, Ovid is taking the risk of spending $40 million to drill the well.[70] But she thinks that Ovid should be satisfied with planning for a 20% profit: $8 million. If all goes according to plan, Ovid would be left with $48 million: $40 million for its expenses and an $8 million profit, which would leave $18 million for Laura. She wants $18 million of the $66 million in oil the

Chart 2: Lease with Royalty
(dividing $66 million of oil production)



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a share of production revenues, often one-eighth, as a royalty."); John S. Lowe, *Representing the Landowner in Oil and Gas Leasing Transactions,* 31 OKLA. L. REV. 257, 274 (1978) ("By custom, the royalty, the share of the production reserved by the landowner for permitting another to develop his land for oil and gas, is 1/8 of the gross production, except in some western states where it may be 1/6."); *Ag Law in the Field: Nicholas Miller (Negotiating an Oil and Gas Lease)*, http://aglaw.libsyn.com/episode-33-nicholas-miller-negotiating-an-oil-and-gas-lease [https://perma.cc/D2HP-DNB5] (noting that standard was once a 1/8 royalty); *cf.* Bruce R. Huber, *The Fair Market Value of Public Resources,* 103 CALIF. L. REV. 1515, 1526 (2015) (noting that federal law also uses the regular 1/8 royalty for coal leases).

67. *See* Lowe, *supra* note 66, at 229–30 (describing why landowners typically receive their royalty share in oil but receive cash for their royalty share of gas).

68. *See id.* at 252 ("Essentially, the lease is an economic partnership between the lessor, who owns the minerals, and the lessee, who possesses the money and expertise to develop the minerals.").

69. In reality the lease is most often drafted by the oil and gas company, *id.* at 259 n.10, the lessee, but in a competitive market it gradually evolves to serve the interests of both parties.

70. *Id.* at 275 ("[T]he prevailing consensus among operators [is] that oil and gas exploration and development is a risky business and that those engaged in it should receive the major portion of any increase in market price.").

well should produce, so she asks for a royalty of 18/66, or 27.3%, of all the oil produced.

Of course, everything may not go according to plan. If the wells were dry, Ovid would lose the money it spent on drilling but at least it would not owe Laura anything. If the wells produced more oil than expected, Ovid and Laura would both earn more money. The lease lets them share the risk and gives them an incentive to cooperate to ensure the oil wells produce as much as possible.[71]

In fact, the lease gives the landowner a *stronger* interest in rapid and robust production than it gives the oil company. The landowner receives a share of production without paying any costs, so the landowner's preference is simple: the more oil the better.[72] The oil company, on the other hand, must also consider costs.[73] Some wells are not worth drilling, even if the landowner would benefit from receiving more royalty. And even if a well would be profitable now, it might be more profitable in the future if the costs of drilling came down or the price of oil went up, so it could be better to wait.[74]

In return for the royalty, the lease gives the oil company the exclusive right to produce oil and gas from the landowner's property for a period of years.[75] First, the oil company gets a "primary term"—a period of years during which the oil company may explore for oil, drill, or simply consider its options.[76] If the company strikes oil and begins production during the primary term, it gets to keep the property throughout a "secondary term"—in the United States, the secondary term typically extends as long as oil and gas is produced.[77] In other words, if the company starts

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71. Giving both parties a share of the ultimate value of a product, rather than a simple flat fee, is a common method of inducing cooperation in contracts. *See* Goldberg, *supra* note 64, at 543–49 (explaining the motivation for such contingent compensation in the film industry). As we will explore further, this traditional lease does not perfectly align the incentives of landowners and oil companies, which is one reason for innovations in leasing and host country agreements over the past century. *See infra* Section II.B.

72. And the time value of money means that sooner is better as well.

73. Bruce M. Kramer, *The Interaction Between the Common Law Implied Covenants to Prevent Drainage and Market and the Federal Oil and Gas Lease*, 15 J. ENERGY NAT. RESOURCES & ENVTL. L. 1, 1–8 (1995) (describing historical development of implied covenants as a response to oil companies' reluctance to drill); Jacqueline Lang Weaver, *Implied Covenants in Oil and Gas Law Under Federal Energy Price Regulation*, 34 VAND. L. REV. 1473, 1486 (1981).

74. Gergen, *supra* note 52, at 1076.

75. Earl A. Brown, Jr., *Elemental Principles of the Modern Oil and Gas Lease,* 17 MONT. L. REV. 39, 42–43 (1955) ("The right of the lessee to drill and produce has been affirmed as an exclusive right within the strict sense of the word, whether or not the word 'exclusive' is used in the granting clause of the lease.").

76. *Id.* at 40–43.

77. Lowe, *supra* note 66, at 259 ("[T]he lease may be extended to a secondary term 'for so long thereafter as oil and gas are produced' by production of oil and gas and payment of a percentage of the gross production, free of the expenses of production, to the lessor.") (footnote omitted). Note that typically the lease will be extended by a single well, even if the land could support many profitable wells. *Id.* at 282 ("Typically, the secondary term of the habendum clause is invoked by the drilling and putting into production of a single well. Thus, an oil and gas lease may be 'held' without obligation to pay delay rentals by the drilling of a

producing oil and gas in the primary term, it can keep producing until all its wells run dry.[78] Wells regularly continue producing oil for decades, so if multiple wells can be sited on a property, the lease on that property may be more or less permanent.[79]

Of course, the *exclusive* right to produce oil and gas means that the landowner cannot allow another oil company to produce on the land. Let's return to Laura's lease with Ovid Oil Company. Imagine that the lease has a five-year primary term and that now, after one year, Ovid has not started drilling a single oil well. Ovid sees no need to move quickly. Thus far, Laura has received no royalty—she will not get her 27.3% royalty share until Ovid begins production and Ovid can keep waiting because there are still four more years in the primary term.[80] Meanwhile, Bendrix Oil Company approaches Laura and says it will pay her a 30% royalty.[81] Laura cannot accept this better offer even though she still has not received any royalty from the oil on her land because she is still in the primary term of her lease with Ovid. For this reason, apart from the eventual royalty she will receive from oil production, Laura will typically ask for money up front to compensate her for taking her land off the market. As a result, oil companies almost always pay a *bonus*—a one-time cash payment—to the landowner at the time of signing.[82]

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single well, no matter how large the area covered by the lease.").

78. To be precise, courts typically allow a lease to continue running so long as a well continues to produce in "paying quantities"—that is, it is reasonably close to profitable. Gergen, *supra* note 52, at 1010 & n.42; Pierce, *supra* note 50, at 467–70; *see also* Lowe, *supra* note 66, at 277–78 ("Some courts considering the question have interpreted the word 'produced' as a shorthand for 'produced in paying quantities to the lessee.'") (citing courts in Texas, Arkansas, Montana, and Oklahoma).

79. There are wells that have operated for 150 years and, in any event, you can often site a new well on the property to continue production before a declining well runs dry. Ken Ward Jr., *Century-Old West Virginia Leases Yield Paltry Gas Royalties. A Suit Could Cut Others' Payouts to a Trickle, Too.*, PROPUBLICA (Nov. 14, 2018), https://www.propublica.org/article/west-virginia-leases-yield-paltry-gas-royalties [https://perma.cc/N2YT-LFTS] (describing controversy over thousands of wells drilled since 1982 on leases as much as 112 years old); *Oldest Continually Operating Oil Well Marks 150 Years*, REUTERS (Aug. 18, 2011), https://www.reuters.com/article/us-oil-oldest/oldest-continually-operating-oil-well-marks-150-years-idUSTRE77H5RP20110818 [https://perma.cc/6CUL-YT2Q].

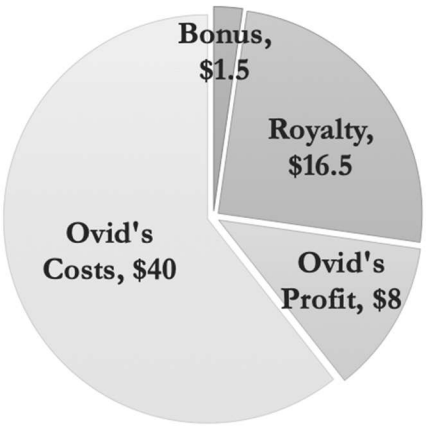
80. *See* Weaver, *supra* note 73, at 1486 ("If the lessee does not develop the property, the lessor will receive little in return for his grant.").

81. Perhaps oil prices have risen or Bendrix thinks these oil wells will be more profitable than Ovid does, or perhaps it is happy to pay her 30% of $66 million—$19.8 million—and plan on recouping just $6.2 million on its $40 million investment.

82. LOWE, *supra* note 12, at 177 ("[L]essors are generally paid a bonus for executing the lease, a payment that may range from a dollar to thousands of dollars per acre leased.").

Laura would have to negotiate her bonus with Ovid.[83] It should be enough to compensate her for taking her property off the market for five years. And it should be enough to show that Ovid is serious about developing her property. If Ovid will not give her a substantial bonus, it would be fair for Laura to worry that Ovid does not really expect to develop her property. Perhaps Ovid does not believe that wells on her land will be profitable unless oil prices rise; it could just be taking a cheap option to tie up her property for five years with no intention of ever producing unless oil prices move higher and make Ovid's share of production (after paying Laura's royalty) suddenly look profitable.[84] On the other hand, if Ovid is willing to pay a substantial bonus for the lease, it probably intends to develop the property.

Chart 3: Lease with Bonus
(dividing $66 million of oil production)



So Laura would ask for some of her compensation up front as a bonus.[85] In our simplified example above, Laura demanded a 27.3% royalty, which, if all went according to the parties' expectations, would end up giving her $18 million over the course of the lease. Instead, Laura could ask for a $1.5 million bonus up front and a slightly lower 25% royalty. If all went according to plan, this structure would end up paying her $16.5 million in royalty over the course of the lease, so Laura would end up with the same $18 million in compensation overall: $1.5 million as a bonus and $16.5 million as royalty. The difference is that she would get $1.5 million up front and thus could be sure that Ovid was serious about developing her property. If Ovid failed to develop the property in the first five years, it would lose the lease, and she could keep the $1.5 million and lease the property to another oil company.

On the other hand, Laura would have to balance her desire for a bonus with her desire for a higher royalty. For the same reasons that she would not want to simply

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83. The bonus can also be seen as compensation for the inconvenience of oil extraction and oil company access to the land because, unlike the royalty, it is not tied to the value of the oil and gas extracted. Dixon v. Mapes, 73 P.2d 1131, 1132 (Okla. 1937). One difficulty with that interpretation, however, is that the bonus is paid even if the oil company never enters the land. If a landowner wants compensation, apart from royalty, for access and surface damages, the landowner should negotiate for that compensation up front. LOWE, *supra* note 12, at 189–95.

84. *See* Gergen, *supra* note 52, at 1076 ("Because a lessee bears the entire cost of exploration and development and reaps only part of the return . . . he has a strong incentive to hold property out of production to speculate on an increase in price, even though the expected return of development to the parties jointly or even to him individually is positive.").

85. *See id.* at 1010 ("Under a typical oil and gas lease, the lessee makes a small bonus payment to the lessor upon execution of the lease . . . .").

sell her oil and gas, she will not want a bonus so high that it limits her royalty too much.[86] After all, a royalty is the payment that will let her share in the upside of unexpectedly good production on her land.[87] So landowners typically want a bonus large enough to show the company intends to develop the project but not so large that it unduly limits the royalty that lets them share in the upside of the project.[88]

C. Early Oil and Gas Concessions

The oil and gas lease, developed in the United States, soon spread across the globe. But in the rest of the world, the government owns the oil and gas in the ground. Most often the national government, rather than the provincial or local government, controls development of these resources.[89] Oil companies negotiate agreements known as "concessions" or "licenses" with these governments, but in the first half of the twentieth century these agreements looked very much like an oil and gas lease.[90]

For example, in 1933, Standard Oil of California signed a concession with the Saudi government that gave it the exclusive right to produce oil and gas in an area larger than the state of Texas for sixty years in return for £155,000 and a royalty.[91] In 1901, the Shah of Persia agreed to a concession with the Anglo-Persian Oil Company covering three quarters of the country for sixty years for a $100,000 bonus, $100,000 in stock, and a 16% royalty.[92] And the Turkish Petroleum Company, which was controlled by the Anglo-Iranian Oil Company,[93] signed a concession with the government of Iraq that offered it a royalty on oil production but specified that no royalty would be paid for the first twenty years of extraction.[94] Thus, these early concessions in countries that would one day dominate oil production sometimes

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86. That is, if she demands most of her compensation as an up-front bonus, she would likely receive less overall because of information asymmetries and would receive a smaller share of the benefit of a very profitable well. *See supra* notes 52–63 and accompanying text.

87. LOWE, *supra* note 12, at 299 ("From a lessor's perspective, the typical lessor prefers not to pass up the chance of profiting from production, which profits could be many times more than the money the lessee would be willing to pay for a lease without royalty.").

88. Pierce, *supra* note 50, at 447 ("Bonus . . . payments are usually small in relation to the . . . market value of the land . . . . The landowner's primary compensation for . . . the [lease] is the potential for risk-free riches in the form of royalty.").

89. CLARK, *supra* note 6, at 12. Canada is, again, one of the exceptions; provinces control most oil and gas production. *See* Stewart, *supra* note 16, at 204.

90. Smith & Dzienkowski, *supra* note 50, at 18–19 ("The Middle Eastern concessions were strikingly similar to the oil and gas leases granted in the United States in the first three decades of this century.").

91. YERGIN, *supra* note 6, at 291; *see* ERNEST E. SMITH, JOHN S. DZIENKOWSKI, OWEN L. ANDERSON, JOHN S. LOWE, BRUCE M. KRAMER & JACQUELINE LANG WEAVER, INTERNATIONAL PETROLEUM TRANSACTIONS 430 (3d. ed. 2010); Note, *From Concession to Participation: Restructuring the Middle East Oil Industry*, 48 N.Y.U. L. REV. 774 (1973). A roughly similar arrangement was struck between Gulf Oil, Anglo-Persian Oil, and Sheikh Ahmad of Kuwait. YERGIN, *supra* note 6, at 297.

92. SMITH ET AL., *supra* note 91, at 429.

93. The Anglo-Persian Oil Company later became British Petroleum. YERGIN, *supra* note 6, at 503.

94. YERGIN, *supra* note 6, at 201–02.

offered oil companies terms far more generous than they would have received from a small landowner in Texas.[95]

Developed countries have also used concessions based on the standard lease.[96] Most often, these concessions set a standard royalty and then encourage multiple companies to bid by submitting a bonus that they are willing to pay for the concession.[97] When bonuses come in very high this can be a sign, as with an individual landowner, that royalties are too low.[98] That is, the government could get more value overall, and ensure it benefits from its best wells, by raising the royalty and settling for a smaller bonus. If royalties are set too high however, oil companies will simply not bid on many concessions; the high royalty share would make the concession unprofitable, or at best marginal, even with a $1 bonus. Thus, a government can monitor the bonuses paid by oil companies at auction to get a rough idea of whether its royalties are extracting too little or too much value from its oil and gas prospects.

II. THE SECOND AGE OF OIL AND GAS LAW

The second age of oil and gas law began in the years leading up to World War II, as the world's largest economies slowly realized two key facts. First, oil was the key to military and economic power. Second, it was finite. The second age of oil and gas law saw a shift in global oil production that was soon reflected in the global balance of power. The United States, once the undisputed center of global oil production, saw this role usurped by Middle Eastern countries that quickly moved to demonstrate their independence from the United States and its allies.

The central event of the second age of oil production was the first war fought for oil and determined by oil: World War II.[99] The war achieved its global character

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95. *See* SMITH ET AL., *supra* note 91, at 433 ("[T]he midwestern farmer who leased his land to an oil company was now in a better contractual position than the Middle Eastern sheik.").

96. *See id.* at 419–20; *see also* Outer Continental Shelf Lands Act, 43 U.S.C. §§ 1301–1356b (2018); TERENCE DAINTITH & GEOFFREY WILLOUGHBY, A MANUAL OF UNITED KINGDOM OIL & GAS LAW 23–25 (1977); Jayni Foley Hein, *Federal Lands and Fossil Fuels: Maximizing Social Welfare in Federal Energy Leasing*, 42 HARV. ENVTL. L. REV. 1, 15–17 (2018) (describing royalties under U.S. leasing system). Subnational units, such as states and provinces, that own natural resources often use such systems as well. For example, because U.S. states own natural resources under their public lands, including offshore lands, Texas uses such a system. *See* TEX. NAT. RES. CODE ANN. §§ 32.107–1073 (West 2011).

97. KIRSTEN BINDEMANN, PRODUCTION-SHARING AGREEMENTS: AN ECONOMIC ANALYSIS 8 (1999).

98. *See supra* notes 85–88 and accompanying text.

99. Colby, *supra* note 4, at 245 ("Without petroleum modern warfare would be impotent and hence we have the life and death struggles which are now going on in the world to reach and control the sources of supply."); *see also* YERGIN, *supra* note 6, at 229 ("The equation—oil equals power—had already been proven on the battlefields of World War I . . . ."); Herbert Feis, *The Anglo-American Oil Agreement*, 55 YALE. L.J. 1174, 1174 (1946) (describing how oil was essential to strategic thinking about the war effort with countries lacking oil forced to "bargain or barter" for oil, leaving them "dependent on the will or bounty of others"). *See generally* ROBERT GORALSKI & RUSSELL W. FREEBURG, OIL & WAR: HOW THE DEADLY

when Germany, facing dwindling oil supplies, invaded Russia with the goal of securing its oil fields.[100] The war further widened when the United States placed an embargo on oil to Japan, prompting Japan's attack on Pearl Harbor and the oil-rich Dutch East Indies.[101] And it was finally won by choking off the Axis powers from oil, allowing United States, Russian, and Persian oil to power the Allied armed forces to victory.[102]

After the War, the companies of the Allied powers—such as Standard Oil, Anglo-Persian, and Royal Dutch Shell—continued to ramp up their production around the world.[103] But the established, aging oil fields in the United States were forced to impose conservation regulations to ensure their remaining resources were not squandered.[104] And countries in the developing world increasingly questioned whether the early concessions that they had signed still served the public interest.[105] In 1960, OPEC, the Organization of Petroleum Exporting Countries, was formed in Baghdad, Iraq; it comprised Saudi Arabia, Venezuela, Kuwait, Iraq, and Iran.[106] Working together over the next twenty years, these countries gradually pressured oil companies to modify their lucrative long-term concessions, first providing the countries with a greater share of their resource revenue, and finally nationalizing the Western oil companies' concessions with varied amounts of compensation.[107] During this same period, Middle Eastern oil came to dominate worldwide production; these countries finally surpassed U.S. output in 1965, ending sixty years of American oil dominance.[108]

STRUGGLE FOR FUEL IN WWII MEANT VICTORY OR DEFEAT (1987).

100. DIETRICH EICHHOLTZ, WAR FOR OIL: THE NAZI QUEST FOR AN OIL EMPIRE, at xiv (John Broadwin trans., 2012); YERGIN, *supra* note 6, at 334–37.

101. *See* EDWARD S. MILLER, BANKRUPTING THE ENEMY: THE U.S. FINANCIAL SIEGE OF JAPAN BEFORE PEARL HARBOR 221, 239–40 (2012); RONALD H. SPECTOR, EAGLE AGAINST THE SUN: THE AMERICAN WAR WITH JAPAN 75 (1985) (explaining that the embargo put the Japanese navy in an impossible situation that required invading the Dutch East Indies and war with the United States); YERGIN, *supra* note 6, at 316–24.

102. *See* DWIGHT D. EISENHOWER, CRUSADE IN EUROPE 233, 368 (1948) (describing the success of the Allies' strategy of cutting off oil supplies to the Axis powers); GORALSKI & FREEBURG, *supra* note 99; RHODES, *supra* note 8, at 265; YERGIN, *supra* note 6, at 346–48. In 1938, "the United States produce[d] about sixty per cent of the world supply." Note, *supra* note 51, at 360 n.2; *see also* MATTHEW HUBER, LIFEBLOOD: OIL, FREEDOM, AND THE FORCES OF CAPITAL 3 (2013) ("As a representative of the U.S. House of Representatives put it in 1941, 'The progress of the people as a whole depends upon this lifeblood of commerce and industry—petroleum.'"); HUBER, *supra* note 102, at 115 (Nixon's energy czar, William Simon declared, "It is hardly an exaggeration to say that petroleum has become the lifeblood of our economy.").

103. *See* Feis, *supra* note 99, at 1175–81 (describing the efforts of the United States and United Kingdom to develop oil reserves abroad).

104. *See infra* Section III.A.

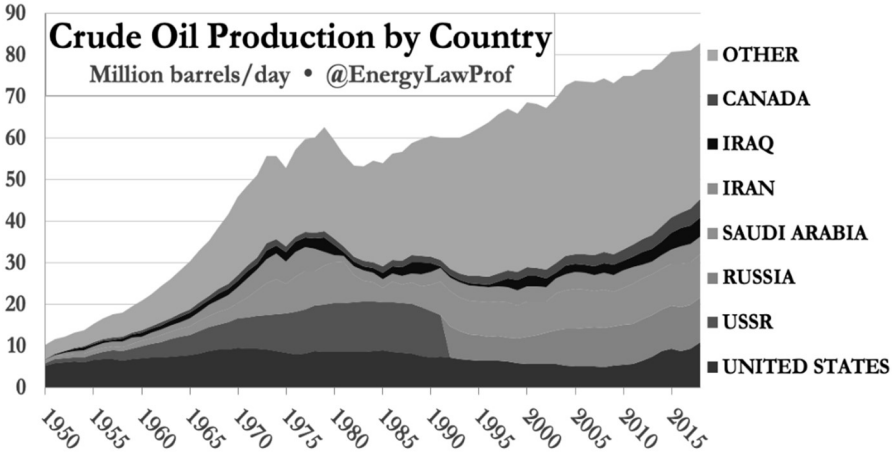
105. *See infra* Section II.B.

106. YERGIN, *supra* note 6, at 522–23.

107. Note, *From Concession to Participation: Restructuring the Middle East Oil Industry*, 48 N.Y.U. L. REV. 774, 788–89 (1973); YERGIN, *supra* note 6, at 522–23, 580–87, 646–52.

108. 2006 ENERGY INFO. ADMIN. ANN. ENERGY REV. 309 tbl.11.5; *see also* CLARK, *supra* note 6, at 194–96.

The shifting balance of oil production was quickly followed by an equally profound shift in the balance of power under international law. In 1962, the United



Nations passed the Resolution on Permanent Sovereignty Over Natural Resources, which acknowledged state sovereignty over natural resources but demanded that any taking of investor property must be for matters of "public utility" and provide "appropriate compensation" for violating investors' settled expectations.[109] By 1974, the world had changed: the United Nations, its ranks swelling with newly independent countries born in opposition to colonialism, passed the Declaration on the Establishment of a New International Economic Order, which declared a right to nationalization.[110]

Since this legal earthquake, Western oil companies have tried to regain some of their legal footing, with varied success. Initially, companies tried to sue in Western courts to enforce their established concessions which seemed, on their surface, so similar to the oil and gas leases that are enforced every day by courts across the United States.[111] But U.S. courts were unwilling to treat these extraordinary foreign bargains as run-of-the-mill domestic leases. For one thing, these concessions were often drafted before courts around the world began to recognize that, contrary to the conceit of a "common law," there was no "transcendental body of law outside of any particular State."[112] So these concessions often did not specify which state or nation's laws should be used to interpret the agreement.[113] The companies may have blithely assumed they were still operating under Anglo-American common law; the courts,

109. G.A. Res. 1803 (XVII), art. 1 ¶ 4 (Dec. 19, 1962), *reprinted in* 2 I.L.M. 223 (1963).

110. G.A. Res. 3201 (S-VI), ¶ 4(e) (May 9, 1974), *reprinted in* 13 I.L.M. 715 (1974).

111. *See* Patrick M. Norton, *A Law of the Future or a Law of the Past? Modern Tribunals and the International Law of Expropriation*, 85 AM. J. INT'L L. 474, 475–85 (1991).

112. Erie R.R. Co. v. Tompkins, 304 U.S. 64, 79 (1938).

113. On the crucial role of choice of law in the aftermath of *Erie Railroad Co. v. Tompkins*, see Willis L. M. Reese & Edmund M. Kaufman, *The Law Governing Corporate Affairs: Choice of Law and the Impact of Full Faith and Credit*, 58 COLUM. L. REV. 1118, 1124–27 (1958).

however, applied the new petroleum laws of the nationalizing countries to negate these claims.[114]

Since these early failures, companies have had greater luck persuading developing nations, eager for new investment, to sign arbitral agreements that waive sovereign immunity, allowing the companies to pursue arbitral claims when their investments are nationalized.[115] But new governments have often proven more than willing to change the terms of established concessions, even if it may require paying an arbitral award.[116] The shifting sands of oil production have created a multipolar world that is here to stay.

A. Limits on the Rule of Capture

As global conflicts showed that world power would depend on oil, the United States began taking steps to conserve the remaining oil in its maturing fields. As noted, the rule of capture encourages waste—waste of reservoir pressure dissipated by too many wells pumping too fast, waste of money spent on these counterproductive wells, and waste of land unnecessarily devoted to these excess wells.[117] In response, U.S. states established new regulatory bodies with the authority to curb this waste.[118] These new state regulators adopted two main types of regulations: limits on how many wells could be drilled (and how much they could pump) and incentives for landowners to team up and share the cost and profit from a smaller number of wells.[119]

As U.S. oil production rose throughout the middle of the twentieth century, state regulators began to place limits on how many wells could be drilled and how much those wells could pump.[120] Regulators promulgated density requirements that

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114. Hunt v. Coastal States Gas Producing Co., 583 S.W.2d 322, 325 (Tex. 1979). Courts have also refused to hear such claims by ruling that they are political questions, Occidental of Umm Al Qaywayn, Inc. v. A Certain Cargo of Petroleum, 577 F.2d 1196, 1201 (5th Cir. 1978), or blocked by sovereign immunity, Libyan Am. Oil Co. v. Socialist People's Libyan Arab Jamahirya, 482 F. Supp. 1175, 1177 (D.D.C. 1980).

115. *See* PETER D. CAMERON, INTERNATIONAL ENERGY INVESTMENT LAW: THE PURSUIT OF STABILITY, at xlvii–xlviii (2010).

116. *See* Guillermo J. Garcia Sanchez, *The Hydrocarbon Industry's Challenge to International Investment Law: A Critical Approach*, 57 HARV. INT'L L.J. 475, 479–80 (2016) (explaining why arbitral awards have not deterred states from modifying their regulations).

117. *See supra* notes 32–49 and accompanying text.

118. These state bodies were coordinated by an Interstate Compact Commission comprising the major oil producing states, minus California. Galvin, *supra* note 61, at 1475 n.101.

119. Gordon A. Goodwin, *Elements of a Negotiated Unit Plan Including Both Private and Public Lands*, 5 UCLA L. REV. 362, 364 (1958) ("Most of the oil producing states have enacted laws providing for well spacing, for limiting production of oil to maximum efficient rates, or to market demand . . . .").

120. LAWRENCE GOODWYN, TEXAS OIL, AMERICAN DREAMS: A STUDY OF THE TEXAS INDEPENDENT PRODUCERS AND ROYALTY OWNERS ASSOCIATION 97–101 (1996) (describing how the Texas Railroad Commission used allowables to manage statewide production); Wm. E. Colby, *The Law of Oil & Gas II: A Consideration of Landowners' Rights, Particularly as Developed in California*, 31 CALIF. L. REV. 357, 369 (1943) (noting "restriction on unlimited

dictated that there could only be one well for a given number of acres.[121] In Texas, often this meant one oil well for every forty acres.[122] Regulators also issued spacing requirements, forbidding wells too close to another well or to a property line.[123] Finally, regulators set an amount of oil or gas that could be pumped per day, week, or month, known as an "allowable," to slow down the race for production.[124]

Regulators also encouraged, and sometimes even required, landowners to team up and develop their oil and gas resources together.[125] If spacing regulations meant small landowners did not have enough land to drill a well, they could "pool" their land with other owners and share the cost and profit of a well.[126] Regulators in some states can also force reluctant owners to pool their land together to drill a single well.[127]

Even more dramatic, the landowners above an extensive oil reservoir could all come together and "unitize" their holdings so that they could drill multiple wells to efficiently develop the reservoir.[128] Many states now encourage such unitization by forcing owners to enter a unit if enough of the reservoir's other owners and well operators agree.[129] The state can also exert more subtle pressure by forbidding the holdout owner from drilling its own wells, making clear that all new production will

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drilling, . . . control of 'reservoir energy' and other similar regulations"); Marshall & Meyers, *supra* note 47, at 702–26 (describing history of state production limits).

121. *See, e.g.*, Kristen van de Biezenbos, *Where Oil Is King*, 85 FORDHAM L. REV. 1631, 1647–48 (2017) (summarizing Texas's conservation regulations); J. Richard Emens & John S. Lowe, *Ohio Oil and Gas Conservation Law—The First Ten Years (1965-1975)*, 37 OHIO ST. L.J. 31, 37 (1976) (explaining Ohio's laws).

122. 16 Tex. Admin. Code §3.38(b)(2)(A); *see also* Robert E. Hardwicke, *Oil-Well Spacing Regulations and Protection of Property Rights in Texas*, 31 TEX. L. REV. 99, 99 (1952).

123. *See* Jacobs, *supra* note 2, at 1208–10 (summarizing state conservation requirements).

124. Hardwicke, *supra* note 18, at 410–12 (explaining that a modern "legislature prohibits the waste of oil and gas" which means it authorizes a board to set "the maximum allowable production from any field" and then set "the allowable production for the various tracts or wells" in the field); *see also* Ford, *supra* note 1, at 1190–200 (surveying state conservation laws including pumping limits).

125. A. Allen King, *Pooling and Unitization of Oil and Gas Leases*, 46 MICH. L. REV. 311, 317–21 (1948).

126. Douglas C. Gregg, *Community Leases and Pooling Clauses*, 7 UCLA L. REV. 289, 290 (1960).

127. *See* Bennion v. ANR Prod. Co., 819 P.2d 343 (Utah 1991) (holding that such an order is valid and not an unconstitutional taking of property).

128. Leslie Moses, *Some Legal and Economic Aspects of Unit Operations of Oil Fields*, 21 TEX. L. REV. 748, 761–62 (1943). Thus, while pooling is designed to bring enough land together to drill a single well under local spacing regulations, unitization is generally done for a whole series of wells covering an entire reservoir. Unitization also requires a much more detailed understanding of the reservoir being produced for two reasons. First, to ensure efficient extraction, all landowners above the reservoir should be included. Second, production from a unitized field is usually divided in proportion to the amount of oil that could have been extracted from each participant's land. In contrast, pooling offers much more rough justice: production is almost always just divided in proportion to the surface acreage that each landowner contributes to the single well.

129. King, *supra* note 125, at 335–37; Note, *supra* note 51, at 363.

only happen in the unitized reservoir.[130] Or the state can simply "shut-in" all wells in an oil and gas field until the owners negotiate a unitization plan.[131] Unitization, however, cuts against the grain of a long history of U.S. private oil and gas extraction, so in the Unitied States it is usually only adopted in two circumstances: when there has been no previous extraction in an area, or to enable enhanced recovery in very old fields that can no longer be produced by traditional methods.[132]

National regulators also moved to require unitization, not just for efficiency, but also as a solution to geopolitical conflict over cross-border reservoirs.[133] In the three decades after World War II, oil companies began producing oil and gas in deeper and deeper waters offshore that fell in areas of conflicting or uncertain jurisdiction.[134] This race for deep water incited a great debate over theories of sovereignty and national jurisdiction that is still raging.[135] Unitization of cross-border reserves is the method that states have used to manage these conflicts over sovereignty.[136]

B. Foreign Alternatives to the Lease

Countries eventually realized that although an oil and gas lease was preferable to a simple sale of resources, it still could be improved upon. For one thing, the lease's simplicity means that it wins the landowner too little money from the very best wells and takes too much money from an oil company drilling a marginally profitable well. Second, oil and gas leases were designed for the individual landowners that own the bulk of U.S. oil and gas, so it contains terms that are not well designed for a sovereign nation looking to develop vast swaths of land over decades. As a result, countries developed new types of host country agreements to benefit from their growing oil production.

1. New Agreements on Profit Sharing

A simple bonus and royalty lease does not take enough money from surprisingly profitable wells. Conversely, it takes too much money from marginal oil and gas prospects, preventing any development of wells that might otherwise provide a

130. *See* Baumgartner v. Gulf Oil Corp., 168 N.W.2d 510 (Neb. 1969).

131. Owners in Buck Draw Field Area v. Wyo. Oil & Gas Conservation Comm'n, 721 P.2d 1070, 1080 (Wyo. 1986) (allowing regulators to shut-in existing oil and gas wells until owners agreed on unitization plan).

132. Such fields are often flooded with water or gases that are injected into the reservoir from old oil and gas wells to force more oil and gas to the surface. If state regulators did not authorize this unitization, pushing gas or water under neighbors' land might be viewed as an actionable trespass. *See* FPL Farming Ltd. v. Envtl. Processing Sys., L.C., 351 S.W.3d 306 (Tex. 2011); R.R. Comm. v. Manziel, 361 S.W.2d 560 (Tex. 1962).

133. *See* Guillermo J. Garcia Sanchez & Richard J. McLaughlin, *The 2012 Agreement on the Exploitation of Transboundary Hydrocarbon Resources in the Gulf of Mexico: Confirmation of the Rule or Emergence of a New Practice?*, 37 HOUS. J. INT'L L. 681, 695–96 (2015).

134. *Id.*

135. *Id. See generally* United Nations Convention on the Law of the Sea, arts. 2–3, *opened for signature* Dec. 10, 1982, 1833 U.N.T.S. 397.

136. *See generally* Sanchez & McLaughlin, *supra* note 133.

modest profit to both an oil company and a host country. How can a country simultaneously ensure it takes full value from the best wells but still encourage oil companies to develop marginal plays? The answer is profit sharing, which countries now regularly implement through two types of host country agreements: the production sharing contract and the joint venture.

To understand why profit sharing helps, let us take another example. Imagine that a country, Norland, is looking to negotiate a concession with Icarus Oil Company. The concession is expected to produce $120 million of oil and require $80 million in development costs.[137] Norland has traditionally used a 20% royalty. So if all goes as planned, Norland will receive $24 million, and Icarus will be left with $96 million. Thus, Icarus will get its $80 million investment back, plus a 20% profit of $16 million.

Imagine, however, what happens if the well proves more profitable than advertised. Suppose that Icarus's well actually produces $200 million in oil, not $120 million, at the predicted $80 million price of development.[138] Perhaps it produces more oil than expected, or maybe the price of oil just went up. Under its concession, Icarus would pay the government somewhat more: the 20% royalty would mean a $40 million payment to the government. But Icarus's net profit would be dramatically increased. After paying its royalty, it would have $160 million left over—it would have doubled its $80 million investment. Norland would have received $40 million from this bonanza well and Icarus would have made a 100% profit of $80 million.

Now consider what would have happened under a 50-50 profit-sharing agreement. The country would have received $60 million of the $120 million net revenue from the project. And the company could hardly have complained; it would still make a

Chart 4: Bonanza with Royalty
(dividing $200 million of oil production)

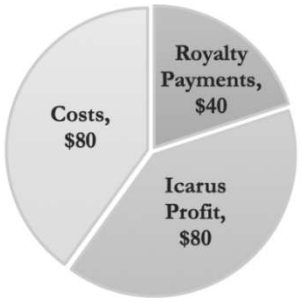
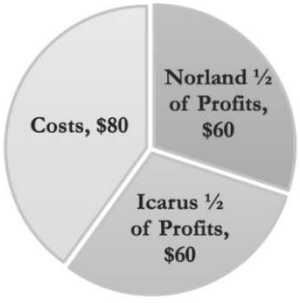


Chart 5: Bonanza with Profit Split
(dividing $200 million of oil production)



75% return—$60 million of profit on its $80 million investment. So a net-profits interest ensures that the government receives more value from bonanza wells without seriously discouraging private investment.

A net-profits interest, unlike a royalty interest, also ensures that the government gets at least some benefit from marginal prospects. What if Icarus found out that the

137. For simplicity, let's imagine that this $80 million in costs includes the bonus that Norland would have demanded in return for this concession.

138. So the well-produced $120 million in net revenue: $200 million in oil minus the $80 million cost of development.

well would be $10 million more expensive than expected—that is, it would cost $90 million? Under the traditional royalty system, it would still owe 20% of production: $24 million of the $120 million of oil produced. But its $120 million in oil, minus its $90 million investment and its $24 million royalty, would leave only $6 million in profit. Would it go forward with such an investment? Probably not—so neither the government nor the company would make any profit at all from this well. The oil would stay in the ground.[139] The government would receive no royalty and it would also miss out on a company investing $90 million that might help support local jobs and industry.

Again, consider what would happen under a 50-50 profit-sharing agreement. If Icarus's exploration showed that its costs would be $90 million, it would expect that its net revenue would be $30 million. It would give half of this to the government, so the government would receive $15 million, and it would keep $15 million for itself. Would it be willing to spend $90 million for a profit of $15 million—that is, a 17% profit? Probably. So the profit-sharing system would benefit both Norland and Icarus by ensuring that the well was developed and giving both parties a significant, if modest, payout.

Chart 6: Marginal with Royalty
(dividing $120 million of oil production)

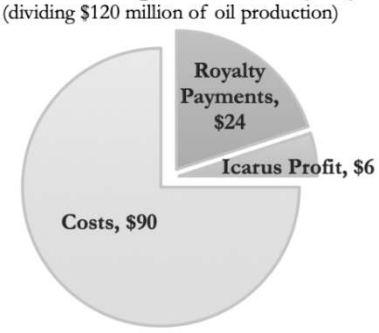
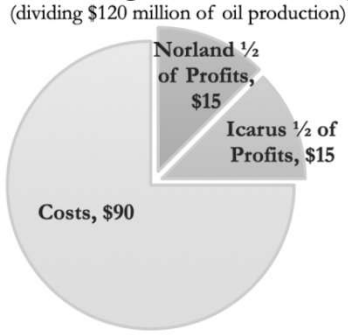


Chart 7: Marginal with Profit Split
(dividing $120 million of oil production)



To secure a net-profits interest, countries developed two new types of host country agreements to make with private oil companies: the joint venture and the production sharing contract. Both of these new types of host country agreements typically employ a government-owned oil production company known as a national oil company.[140] The simplest way of ensuring a share of net profits is the joint venture agreement: the national oil company receives a percentage of the concession agreement through a joint venture with the private international oil company chosen

139. Note that the royalty creates a conflict of interest between the government, which would still receive a handsome royalty if the well was drilled, and the company, which would not receive enough profit to make the well worthwhile. As Judge Posner explained in *Finley v. Marathon Oil Co.*, "conflict of interest is built into any royalty arrangement." 75 F.3d 1225, 1230 (7th Cir. 1996).

140. Ever since these national oil companies were formed, they have played a pivotal role in the international oil industry and global geopolitics. *See e.g.,* BAKER INST., THE ROLE OF NATIONAL OIL COMPANIES IN INTERNATIONAL ENERGY MARKETS (2007), https://www.bakerinstitute.org/center-for-energy-studies/role-national-oil-companies-international-energy-markets/ [https://perma.cc/AYH4-LE4P].

to develop the prospect. Thus, the private international oil company, often called an IOC ("international oil company"), simply shares profits with the public national oil company, often called an NOC ("national oil company"), as though they were partners.

The second new type of host country agreement is the production sharing contract, first developed by Indonesia.[141] This contract has several characteristic features, including that the private international oil company technically works for the public national oil company.[142] But the production sharing contract also provides compensation to the host country that approximates a net-profits interest.[143] To accomplish this, the production sharing contract allows the oil company to take a greater share of production while it is recovering its costs.[144] Oil extracted while the company is still recovering its costs is known as "cost oil"; in theory, the company's share could be as high as 100%.[145] After the IOC recovers its cost, it then must share a much higher percentage of the oil it produces to ensure the country fully shares in the profits from a very profitable well.[146] This oil—the oil that comes after the company has recovered its costs—is known as "profit oil."[147]

Profit sharing has some downsides as well. The biggest drawback is that the resource owner must account for the costs of the oil company to ensure that the share of the profits it receives truly reflects the profitability of the company's oil wells.[148] This is why private leases in the United States generally use a simple royalty, and not a net-profits interest—a net-profits interest forces the landowner to verify an accounting of the profits of the oil company.[149] This can be complicated because the

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141. *See generally* BINDEMANN, *supra* note 97, at 10; SMITH ET AL., *supra* note 91, at 463–69; Robert Fabrikant, *Production Sharing Contracts in the Indonesian Petroleum Industry*, 16 HARV. INT'L L.J. 303, 313 (1975).

142. In practice, however, the national oil company typically leaves nearly all decisions to the international oil company. *See* SMITH ET AL., *supra* note 91, at 467–68.

143. BINDEMANN, *supra* note 97, at 1.

144. *Id.*

145. *Id.* at 14.

146. *Id.* at 1.

147. *Id.*

148. Another industry that uses net-profits interest is the film industry, and scholars have developed the term "Hollywood Accounting" to describe the inflated expense claims that can eat into or entirely devour the net-profits interest of creative artists. Goldberg, *supra* note 64, at 524–25. *See generally* Tim Connors, *Beleaguered Accounting: Should the Film Industry Abandon Its Net Profits Formula?*, 70 S. CALIF. L. REV. 841, 863–75 (1997). Film companies have routinely been found liable for inflating cost claims to reduce what is paid out in net profits. *See* Celador Int'l, Inc. v. ABC, 499 F. App'x 721 (9th Cir. 2012) (affirming $269 million award against Walt Disney Co. for improperly deducting costs from net profits).

149. To verify that they are paid accurate royalties, landowners simply need to know the volume of oil or gas produced and the amount that that oil and gas was worth. This is much simpler but still results in many disputes when there is a question what produced gas is worth. Because it is so expensive to transport gas, which generally must be moved by pipeline, the price of gas varies significantly by location. James W. Coleman, *Pipelines & Power-Lines: Building the Energy Transport Future*, 80 OHIO ST. L.J. 263, 272–73 (2019); James W. Coleman, *Beyond the Pipeline Wars: Reforming Environmental Assessment of Energy Transport Infrastructure*, 2018 UTAH L. REV. 119, 146-48 (2018); Adebola S. Kasumu, Vivian

company's costs include not just the specific equipment used for the well but also a fraction of many employees' time, of equipment used at several wells, and of shared company expenses. How big a fraction should apply to each specific well to calculate its net profits? Few private landowners would want to regularly police such an accounting.[150]

For countries, however, the accounting difficulties may be worth it. As noted, receiving a share of net-profits ensures that the country still gets some profit from marginal wells and gets a substantially larger benefit from bonanza wells. And if the country assesses an income tax on net profits, it already must do some verification of a company's reported costs. A net-profits interest, however, requires significantly more accounting than income taxation because the country must audit the costs associated with *each* joint venture rather than simply looking at the company's overall profitability.[151] Similarly, the country must verify a company's costs for *each* production sharing contract to determine how much cost oil the international oil company should be allowed to recover under that contract.[152]

Net-profits interests have one more related downside; they may encourage companies to spend more than is really necessary, lowering the profits that the oil company shares with the national oil company. When an international oil company is sharing the profits, the national oil company shares its costs as well as its revenues—so the international oil company is only paying half of the cost of each well. Sharing costs encourages excess spending on the well. After all, why not spend

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Li, James W. Coleman, Jeanne Liendo & Sarah M. Jordaan, *Country-Level Life Cycle Assessment of Greenhouse Gas Emissions from Liquefied Natural Gas Trade for Electricity Generation*, 52 ENVTL. SCI. & TECH. 1735, 1739 (2018) (documenting world variation in natural gas prices). As a result, oil companies often claim that gas was worth far less at the well than what they sold it for after piping it to a more attractive market. *See* Heritage Res., Inc. v. NationsBank, 939 S.W.2d 118 (Tex. 1996); Abrahm Lustgarten, *How Oil and Gas Drillers Avoid Paying Royalties to Landowners*, PACIFIC STANDARD (Aug. 30, 2013), https://psmag.com/environment/oil-gas-drillers-avoid-paying-royalties-landowners-65236 [https://perma.cc/L43Q-NPA5] (last updated June 14, 2017). There are relatively fewer disputes about the amount produced or about the price of oil, which trades at similar prices in geographically distant markets.

150. The difficulties of needing to police such an accounting to ensure full value on a net-profits interest is well dramatized in the Hollywood context. *See* PIERCE O'DONNELL & DENNIS MCDOUGAL, FATAL SUBTRACTION (1992) (describing Buchwald v. Paramount Pictures Corp., 13 U.S.P.Q.2d 1497 (Cal. Super. Ct. 1990), among other cases).

151. Accounting for the cost and profit of each well is known as "ring-fencing." Emil M. Sunley, Thomas Baunsgaard & Dominique Simard, *Revenue from the Oil and Gas Sector: Issues and Country Experience*, *in* FISCAL POLICY FORMULATION AND IMPLEMENTATION IN OIL-PRODUCING COUNTRIES 157–58 (J.M. Davis, R. Ossowski & A. Fedelino eds., 2003).

152. If the government could perfectly calculate the cost of each well, it could presumably extract all the economic rent from its oil and gas—all its value less the cost of extracting it and a normal profit. *See supra* notes 56–59. But this is impossibly complex as the United States found when it attempted to regulate natural gas prices. *See* Richard J. Pierce, Jr., *Natural Gas Regulation, Deregulation, and Contracts*, 68 VA. L. REV. 63, 69–72 (1982) (citing DEP'T OF ENERGY, REDUCING U.S. OIL VULNERABILITY, at II-B-27 (1980)) (explaining why, in practice, this system locked in natural gas reserves that could otherwise have been sold profitably, costing society between $2.5 and $5 billion per year).

a bit more on the newest equipment or pay your employees slightly more when the country is picking up half the bill? The oil company could even curry favor with its regular outside contractors by paying them a bit extra for such a job and hope that the contractor, in return, will offer it a better deal some other time when the company is paying the full cost.

2. Limiting the Geographic and Time Scale of Concessions

Countries also realized that two other provisions of the typical U.S. lease were a poor fit for nations that owned oil and gas. The leases were too unlimited in time and area. As a result, oil companies could hold a near-permanent option on vast swaths of land without drilling many wells or, consequently, providing much wealth to the nations that signed these early agreements. In the United States, this problem was often addressed by creative judicial interpretation of leases that forced oil companies to drill more wells even when the plain terms of the lease seemed to impose no such obligation.[153] Nations facing this same problem soon began to modify their agreements so that oil companies would share the nation's interest in timely production.

First, the indefinite term of these concessions proved to be an intolerable limitation on sovereign states.[154] Is it reasonable for a government to commit its people's resources for all time, or even for an indefinite "secondary term" that could last a century? What if the form of government is in flux? Should new governments really have no say in the operation of oil and gas companies in their territory? In theory, should the government or a private company be willing to pay more for the right to extract resources in a country seventy-five years from now? Most economists say that this right should be worth little to a company, which has a high discount rate and a short time horizon, and more to a nation, which typically can borrow money at a cheaper rate than a private company and thus has less need for ready cash.[155] In accordance with this logic, countries began limiting their concessions to two or three decades rather than six or more.[156]

Second, signing a concession for a huge government territory is very different than signing an agreement for a single farmstead. Recall that a typical Texas oil and gas lease may be maintained in perpetuity by a single well.[157] As long as the oil company keeps producing that single well, it has the exclusive option to produce more oil from the land. When a new oil and gas boom rolls around, the company will be able to drill for more oil under its existing lease, and the landowner will not be able to shop around for a new oil company and higher royalty. If a farmstead knows

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153. Pierce, *supra* note 50, at 452–57; Weaver, *supra* note 73, at 1485–94.

154. *See* Kenneth S. Carlston, *Concession Agreements and Nationalization*, 52 AM. J. INT'L L. 260, 265–67 (1958) (discussing the problem of changed circumstances).

155. Lawrence H. Summers, *Investment Incentives and the Discounting of Depreciation Allowances*, *in* THE EFFECTS OF TAXATION ON CAPITAL ACCUMULATION 300 (Martin Feldstein ed., 1987) (reporting firm discount rates of 8% to 30%).

156. *See* David N. Smith & Louis T. Wells, Jr., *Mineral Agreements in Developing Countries: Structures and Substance*, 69 AM. J. INT'L L. 560, 566 (1975).

157. Lowe, *supra* note 66, at 282.

that it has multiple oil reservoirs on its land, it may want to take steps to ensure they are leased separately.

But the countries that signed the early oil and gas concessions had countless oil and gas reservoirs; it was simply intolerable that such large areas of land, covering so many prospects, had been routinely given to one company.[158] These large-area concessions made it impossible to find out what level of royalties these countries might have been able to secure in an open market. So countries began offering smaller blocks of land for new concessions.[159]

By the end of the second age of oil and gas law, the balance of power had palpably shifted to the new oil-producing countries in the Middle East and elsewhere. The national oil companies of these countries dominated global production. These nations used increasingly customized forms of host country agreements—concessions, joint ventures, and production sharing contracts—making them the center of innovation in international oil and gas law. And these new agreements provided oil-producing countries with an increasing share of the oil produced from their land. But a new age of oil would soon be born at the historic center of the oil industry, a petroleum renaissance driven by fracking in the United States.

III. THE THIRD AGE OF OIL AND GAS LAW

The United States is in the middle of the biggest oil boom that the world has ever seen. Directional drilling and hydraulic fracturing—colloquially known as "fracking"[160]—have unlocked staggering quantities of oil and gas across the country. The United States doubled its oil production between 2010 and 2018.[161] By 2015, the United States produced both more petroleum and more natural gas than any other nation.[162] Then in one year, the United States further increased its oil production by

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158. Conversely, small tracts give rise to several problems that do not exist when the country owns all oil and gas mineral resources. *See, e.g.*, William O. Huie, *Apportionment of Oil and Gas Royalties*, 78 HARV. L. REV. 1534 (1965).

159. *See* SMITH ET AL., *supra* note 91, at 448–49.

160. Some members of the oil industry have, at times, objected to the term "fracking" and its spelling. In 2012, Chesapeake Energy's vice president for Strategic Affairs argued that it was a "a co-opted word and a co-opted spelling used to make it look as offensive as" possible. Jonathan Fahey, *'Fracking': Made-Up Word Not Cracking Up The Natural-Gas Industry*, SEATTLE TIMES, Jan. 26, 2012, https://www.seattletimes.com/nation-world/fracking-made-up-word-not-cracking-up-the-natural-gas-industry/ [https://perma.cc/B2HB-4LTN]. But the fact is that it is the most common term for the process among both industry and the public. In fact, by 2016, Chesapeake Energy's vice president of operations was bragging that the company had perfected the "monster frack," a process of "unleashing hell on every gas molecule downhole," that it liked to call "propageddon." Joe Carroll & David Wethe, *Chesapeake Energy Declares 'Propageddon' With Record Frack*, BLOOMBERG, https://www.bloomberg.com/news/articles/2016-10-20/chesapeake-declares-propageddon-with-record-frack-in-louisiana [https://perma.cc/3LGF-2DSX].

161. U.S. ENERGY INFO. ADMIN., PETROLEUM & OTHER LIQUIDS: CRUDE OIL PRODUCTION, https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbblpd_m.htm [https://perma.cc/K66V-WKTU] (showing U.S. production rising by 2,081,000 million barrels per day from August 2017 to August 2018).

162. Hein, *supra* note 96, at 8.

over two million barrels per day.[163] A major oil power like Nigeria has been ramping up its oil production for more than sixty years and still produces less than two million barrels per day.[164] The United States added that capacity to world oil production in just a year, easily outpacing the biggest previous oil boom which occurred in Saudi Arabia in the early 1970s.[165] This boom dwarfs previous oil and gold rushes—there is simply no historical analogue for the scale of the oil and gas revolution currently sweeping the United States.[166]

This new age of oil has begun a third age of oil and gas law. It is being defined by fracking, increased climate regulation, and more sophisticated landowners. Fracking has mitigated some of the problems that required the existing body of conservation law while raising new issues. At the same time, public landowners are facing a new pressure that may cut against maximum production: growing concern over the costs of climate change. With the new flood of oil, countries are realizing that climate action may require curbs to oil production before their oil resources are exhausted. Finally, public landowners have grown more sophisticated in their efforts to ensure they receive maximum benefit from their oil and gas resources. This Section concludes by suggesting how private landowners can learn from the innovative new agreements devised by public landowners to ensure they receive full benefit from the unprecedented boom flooding the country with new oil and gas wealth.

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163. *Supra* note 161.

164. *Country Comparison: Crude Oil - Production*, CIA WORLD FACTBOOK, https://www.cia.gov/library/publications/the-world-factbook/rankorder/2241rank.html [https://perma.cc/7WWM-ABMJ] (Nigeria produced 1,871,000 barrels of oil per day in 2016).

165. 2006 ENERGY INFO. ADMIN. ANN. ENERGY REV., *supra* note 108, at 309 tbl.11.5 (showing that the largest previous one-year jump was Saudi Arabia rising 1.58 million barrels per day from 1972 to 1973). At that time, oil was worth $1.86 per barrel, which is $10.91 in 2017 dollars, so the market value of the current boom, which is 30% faster and with oil priced at about $65 per barrel, is approximately seven times greater. M. Garside, *Average Annual OPEC Crude Oil Price From 1960 to 2019 (in U.S. Dollars Per Barrel)*, STATISTA, https://www.statista.com/statistics/262858/change-in-opec-crude-oil-prices-since-1960/ [https://perma.cc/5ZCT-84B5] (last updated Sept. 18, 2019). And, of course, this oil boom was accompanied by a staggering boom in natural gas production. James W. Coleman, *Importing Energy, Exporting Regulation*, 83 FORDHAM L. REV. 1357, 1364–66 (2014).

166. *See supra* note 165. For comparison, the California gold rush produced $50 million in gold per year, with a peak of $80 million in 1852, which would be about $2.6 billion in 2018 dollars. *See* JOHN DOBSON, BULLS, BEARS, BOOM, AND BUST: A HISTORICAL ENCYCLOPEDIA OF AMERICAN BUSINESS CONCEPTS 82 (2007); MALCOLM J. ROHRBOUGH, DAYS OF GOLD: THE CALIFORNIA GOLD RUSH AND THE AMERICAN NATION (1997); CPI Inflation Caculator, *U.S. Dollar Inflation Calculator*, https://www.officialdata.org/ [https://perma.cc/U8WZ-WZDM]. Just the annual increase in U.S. production in 2018 was worth over $49 billion. U.S. ENERGY INFO. ADMIN., PETROLEUM & OTHER LIQUIDS: CRUDE OIL PRODUCTION, https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbblpd_m.htm [https://perma.cc/QA4L-NCYL] (showing U.S. production rising by 2,081,000 barrels per day from August 2017 to August 2018).

A. Modifying the Rule of Capture for Fracking

Fracked wells are fundamentally different from conventional oil and gas wells because they cost far more to complete, they produce more oil and gas up front and then decline more rapidly, and they more commonly produce oil and gas together because it is difficult to target just one or the other. To understand fracking, it is helpful to first understand the conventional oil and gas production that preceded it. Fossil fuels like oil, gas, and coal are all hydrocarbons—composed of carbon and hydrogen atoms. These molecules can be burned to release carbon dioxide, energy, and steam. The lightest hydrocarbon, with just one carbon and four hydrogen atoms is methane, which comprises the vast majority of natural gas.[167] Slightly heavier hydrocarbons, with up to five linked carbon atoms, can either be gas or liquid, depending on temperature and pressure—these are called natural gas liquids or condensates.[168] Crude oil is a mix of hydrocarbons that are yet heavier—the longer the carbon chain, the heavier and thicker the oil.[169]

Oil and gas is formed from decomposed organic matter—once living creatures—compressed underground at high temperatures until they became a mix of oil and gas hydrocarbon molecules.[170] Once formed, these hydrocarbons rise toward the earth's surface through permeable rocks until they run into a ceiling of impermeable rock.[171] Because oil and gas can flow freely through the permeable reservoir beneath this impermeable ceiling, the top of the reservoir typically contains gas, because it is lighter, and the bottom of the reservoir typically contains the heavier oil.[172] A conventional oil and gas producer simply drills a well through the layer of impermeable rock, accessing the free-flowing oil and gas in the permeable rock "reservoir" beneath.[173]

Hydraulic fracturing and directional drilling extract oil from a different kind of reservoir: fracking unlocks oil and gas that is trapped in tiny pores distributed through impermeable shale rock layers.[174] The drill first descends through a mile or more of rock and then, over a few hundred feet, turns ninety degrees to horizontally thread the targeted shale layer.[175] The fracturing team uses a series of explosive charges to

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167. U.S. DOMESTIC & INT'L BUS. ADMIN., STAFF HANDBOOK ON NATURAL GAS 6.5 (1975).

168. James W. Coleman & Alexandra B. Klass, *Energy and Eminent Domain*, 104 MINN. L. REV. 659, 681 n. 119 (2019).

169. H.S. BELL, AMERICAN PETROLEUM REFINING 44–45 (1923).

170. Colby, *supra* note 4, at 250 (quoting Burke v. S. Pac. R.R., 234 U.S. 669, 679 (1914)).

171. *See* Ford, *supra* note 1, at 1176–77 (explaining oil and gas reservoirs with diagrams); Colby, *supra* note 120, at 358.

172. Beverly May Carl, Comment, *Conservation and Price Fixing in the California Petroleum Industry*, 29 S. CAL. L. REV. 470, 470 (1956) (explaining the "gas cap" at the top of an oil and gas reservoir). Beneath both the gas and oil layers is a layer of water. *Id.*

173. Ford, *supra* note 1, at 1171–72 (describing how oil and gas flows out of the reservoir into the well).

174. *See* Coleman & Klass, *supra* note 168, at 675; David B. Spence, *Federalism, Regulatory Lags, and the Political Economy of Energy Production*, 161 U. PA. L. REV. 431, 438 (2013).

175. Amanda C. Leiter, *Fracking, Federalism, and Private Governance*, 39 HARV. ENVTL. L. REV. 107, 112–13 (2015).

precisely puncture this rock layer along the horizontal length of the well.[176] These initial cracks are then lengthened using high-pressure water that further fractures the rock.[177] Sand is mixed into this water to hold these cracks open once the water is removed from the well.[178] The previously trapped oil and gas is now able to flow back up the well through the fractured shale rock.[179] Because these oil and gas molecules were trapped in impermeable rock before extraction, and could not move around like oil and gas in a conventional reservoir, they never had the chance to separate into crude oil and natural gas before they were extracted. So fracking can produce an unpredictable mix of oil, gas, and natural gas liquids—that is, of short and longer hydrocarbons.[180]

These new fracking techniques and technology are making wells increasingly expensive compared to simple vertical wells,[181] but they produce so much oil and gas that they can be very profitable. And fracked wells can provide a profit more quickly because they are producing more and more of their ultimate production in just the first year or two of operation.[182]

Fracking modifies the traditional concerns addressed by the rule of capture.[183] First, it mitigates the traditional problem of pulling oil from a common reservoir

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176. *See* Thomas W. Merrill & David M. Schizer, *The Shale Oil and Gas Revolution, Hydraulic Fracturing, and Water Contamination: A Regulatory Strategy*, 98 MINN. L. REV. 145, 153–54 (2013).

177. Coleman & Klass, *supra* note 168, at 675–76.

178. *Id.*

179. John M. Golden & Hannah Wiseman, *The Fracking Revolution: Shale Gas as a Case Study in Innovation Policy*, 64 EMORY L.J. 955, 968–74 (2015) (describing the fracking process).

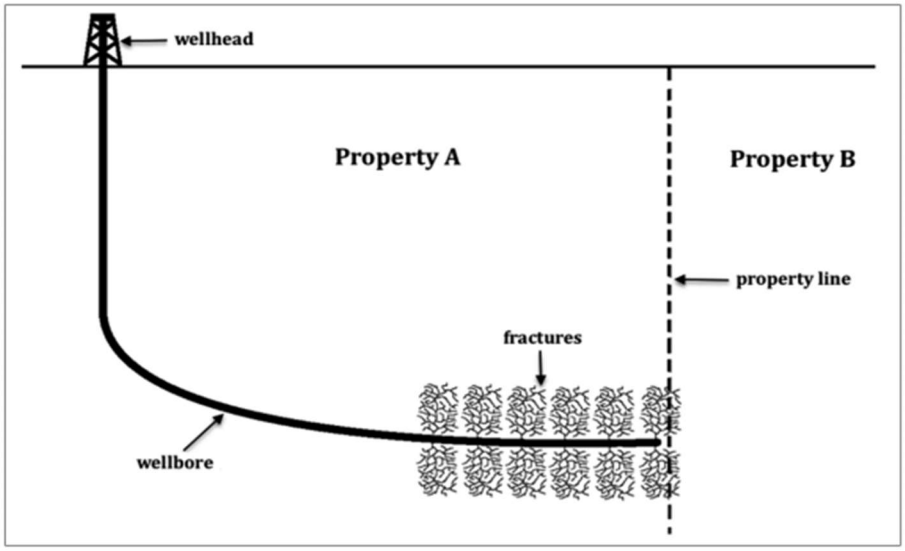
180. Jude Clement, *The Rise of U.S. Associated Natural Gas*, FORBES (June 3, 2018), https://www.forbes.com/sites/judeclemente/2018/06/03/the-rise-of-u-s-associated-natural-gas/#354fac5d4bd7 [https://perma.cc/37X3-NQDJ].

181. LEONARDO MAUGERI, THE SHALE OIL BOOM, A U.S. PHENOMENON, HARVARD BELFER CENTER 12 (2013) (shale wells now cost $5.5 to $10.5 million each) http://www.belfercenter.org/sites/default/files/legacy/files/USShaleOilReport.pdf [https://perma.cc/D32P-H7KG]; *Hydraulically Fractured Horizontal Wells Account for Most New Oil and Natural Gas Wells*, U.S. ENERGY INFO. ADMIN. (Jan. 30, 2018), https://www.eia.gov/todayinenergy/detail.php?id=34732 [https://perma.cc/V7F5-HSAH].

182. John Kemp, *Why the Shale Revolution is Not About to End*, REUTERS (Aug. 29, 2014), http://www.reuters.com/article/shale-usa-drilling-kemp-idUSL5N0QZ3U720140829 [https://perma.cc/S7TK-2MGQ].

183. Colleen E. Lamarre, Note, *Owning the Center of the Earth: Hydraulic Fracturing and Subsurface Trespass in the Marcellus Shale Region,* 21 CORNELL J.L. & PUB. POL'Y 457, 470 (2011) ("Though the rule of capture limits landowners' legal rights against other landowners who extract oil and gas from common reservoirs, the process of hydraulic fracturing may differ from other drilling processes and therefore provide for alternative theories of liability."); Murphy Expl. & Prod. Co.—USA v. Adams, 560 S.W.3d 105, 111 (Tex. 2018) ("[C]ommentators have recognized that hydrocarbons in 'the tight reservoirs developed by horizontal drilling . . . are not susceptible to migration in the same fashion as found in formations traditionally targeted by vertical drilling.'") (quoting Benjamin Holliday, *New Oil and Old Laws: Problems in Allocation of Production to Owners of Non-Participating Royalty Interests in the Era of Horizontal Drilling,* 44 ST. MARY'S L.J. 771, 813 (2013)) (citing Kelly Hwa, Note, *Hydraulic Fracturing and Forced Pooling Laws: Why Fracking Operators' Use*

underlying neighbors' property. Fracking is designed to pull oil from impermeable rock layers so oil will not flow from under a neighbor's land unless that land is also fractured.[184] You may not drill under your neighbor's land so to a first approximation, fracking will not allow you to pull oil from your neighbor.[185] Second, it somewhat mitigates the traditional concern that a race for production will lead to a long-term collapse in oil prices: production from fracked wells trails off quickly, so if prices collapse from new wells, then companies will stop fracking, excess supply will quickly dry up, and prices will recover.[186] Thus, fracked wells naturally play a role as a marginal source of new production.[187]



Source: Caleb Madere, *Covert Capture: Hydraulic Fracturing and Subsurface Trespass in Louisiana*, 75 LA. L. REV. 865, 867 (2015).

Fracking, however, does create two new complications. First, although you cannot drill under your neighbor's land, if your horizontal wellbore comes close to the property line, the rock fractures that spread from the wellbore may extend under your

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of Decades-Old Laws to Compel Access to Properties Must Be Reexamined, 63 WAYNE L. REV. 105, 121 (2017) (noting the non-migratory nature of shale gas and the minimal risk of drainage from adjoining property in the horizontal drilling context)).

184. Coleman & Klass, *supra* note 168, at 675.

185. Hastings Oil Co. v. Tex. Co., 234 S.W.2d 389, 396 (Tex. 1950). If you have permission from the neighboring surface owners, you may, however, drill through another parties' neighboring mineral estate, so long as you do not have an opening in the well, known as a "take point" that would pull oil from their mineral estate. Lightning Oil Co. v. Anadarko E&P Onshore, 520 SW.3d 39, 51 (Tex. 2017).

186. Likewise, if prices rise from growing demand, new fracking can produce a burst of new oil to meet this demand.

187. Fracking's quick payoff also helps companies limit their risk from long-term changes to oil prices. Even if slowing global demand could limit oil prices in the future, that will have little impact on fracked wells that provide their main payoff in just months after drilling.

neighbor's land.[188] Are these fractures more like a slant well, drilled under your neighbor's land, or should they be ignored under the rule of capture?[189] The Texas courts have generally held that these fractures may be ignored,[190] but courts elsewhere have disagreed.[191] Second, because you must actually drill through the shale reservoir to extract oil, fracking creates a new urgency to secure the cooperation of neighboring landowners. The rule of capture meant that a holdout landowner could simply be ignored; wells on neighbors' land would drain the full reservoir. But to drill a horizontal well that could extend more than a mile, a driller must have permission to drill under each property along this route. For this reason, several states have expanded their force-pooling or unitization statutes, requiring reluctant landowners to let companies drill beneath their property so that their neighbors can extract the oil and gas under their land.[192]

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188. *E.g.*, FPL Farming Ltd. v. Envtl. Processing Sys., L.C., 351 S.W.3d 306 (Tex. 2011); Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1 (Tex. 2008).

189. Caleb Madere, *Covert Capture: Hydraulic Fracturing and Subsurface Trespass in Louisiana*, 75 LA. L. REV. 865, 867 (2015).

190. *Id.*

191. Stone v. Chesapeake Appalachia, LLC, No. 5:12–CV–102, 2013 WL 2097397 (N.D.W.Va. Apr. 10, 2013), *vacated by* Stone v. Chesapeake Appalachia, LLC, No. 5:12–CV–1022013, WL 7863861 (N.D.W.Va. July 30, 2013); *see also* Briggs v. Sw. Energy Prod. Co., 184 A.3d 153 (Pa. Super. Ct. 2018), *vacated and remanded*, 2020 WL 355911, at *12–13 (Pa. Jan. 22, 2020) (rejecting the argument that drainage from a neighbor's property to a fracked well is inherently a trespass and leaving undecided whether fractures extending on to a neighbor's property are a trespass).

192. *See, e.g.*, 58 PA. STAT. AND CONS. STAT. ANN. § 34.1 (West 2019); ABBY HARDER, COMPULSORY POOLING LAWS: PROTECTING THE CONFLICTING RIGHTS OF NEIGHBORING LANDOWNERS, NATIONAL CONFERENCE OF STATE LEGISLATURES (2014), http://www.ncsl.org/research/energy/compulsory-pooling-laws-protecting-the-conflicting-rights-of-neighboring-landowners.aspx [https://perma.cc/NTM6-D9Z6] ("The increase in the use of horizontal fracturing has made mandatory pooling laws particularly relevant. Without a mandatory pooling order, the owner of oil and gas on the opposite side of a non-consenting gas owner could be 'blocked' so that the horizontal arms of the main hydraulic fracturing well could not reach this property."); Fenner L. Stewart, *When the Shale Gale Hit Ohio: The Failures of the Dormant Mineral Act, Its Heroic Interpretations, and Grave Choices Facing the Supreme Court*, 43 CAP. U. L. REV. 435, 436–38 (2015) (providing a history of the rise of hydraulic fracturing in the United States and some of its legal consequences); Fenner L. Stewart & Allan Ingelson, *Regulating Energy Innovation: US Responses to Hydraulic Fracturing, Wastewater Injection and Induced Seismicity*, 35 J. ENERGY & NAT. RESOURCES L. 109 (2017) (providing a history of, and introduction to, hydraulic fracturing in the United States as well as some discussion of its rapid growth from 2010 to 2015); Fenner L. Stewart & Anthony G. Cioni, *Unconventional Risk Allocation: Managing the Lifecycle of Shale Projects*, THE NEGOTIATOR (Oct. 2015), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2683633 [https://perma.cc/ML6F-HP49] (illustrating how the lifecycle of hydraulically fractured assets is different than conventional assets, radically changing risk location between participants in joint ventures, and demanding new contractual arrangements).

B. Climate Limits

Climate change is making some countries reconsider one basic premise of the oil and gas lease or concession: the presumption that more production is always in the interest of the public landowner. The primary compensation for landowners who lease their oil and gas resources is a royalty: a share of production. The landowner does not pay the costs of production, so the landowner wants as much production as soon as possible no matter the cost. As a result, when landowners draft a lease, they typically add provisions designed to prod a lethargic or conservative oil company to drill sooner and drill more.[193] In recent years, countries have begun to consider how these provisions in public leases may conflict with climate goals that may require a slowdown in oil and gas production.

Alberta, for example, has placed a cap on overall greenhouse gas emissions from its oil sands sector. Companies have responded by asking permission to "strand" some oil—leaving barrels of oil in the ground rather than maximizing production.[194] This is necessary because the typical concession, like the typical lease, requires an oil and gas company to maximize production.[195]

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193. And if a landowner does not include such provisions, an oil company with limited resources may focus drilling on landowners who do.

194. Chester Dawson, *Suncor Energy Seeks Permission to Abandon Some Oil-Sands Assets*, WALL ST. J. (Sept. 7, 2016), https://www.wsj.com/articles/suncor-energy-seeks-permission-to-abandon-some-oil-sands-assets-1473286608 [https://perma.cc/M45J-QQ6J] ("Canada's largest oil producer, is in talks with government officials for permission to 'strand,' or abandon, some high cost and greenhouse gas-intensive crude-oil deposits, the company's chief executive said Wednesday. The Calgary-based company is seeking an easing of rules designed to maximize oil-sands production from leases on government land, CEO Steve Williams said at a Barclays energy conference in New York, reiterating a strategy he first announced in July."); Dan Healing, *Suncor Proposes Leaving Oil Sands in Ground to Cut Greenhouse Gas Emission Intensity*, GLOBE & MAIL (July 28, 2016), https://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/suncor-discussing-with-alberta-government-possibility-of-leaving-oil-in-ground/article31153337/ [https://perma.cc/J9VA-XZ5X]; Jesse Snyder, *Suncor Energy Inc Pushes 'Stranded' Assets Idea to Meet New Environmental Regulations*, FIN. POST (Aug. 4, 2016), https://business.financialpost.com/commodities/energy/suncor-energy-inc-swings-to-loss-after-alberta-wildfires-hit-production [https://perma.cc/KNW7-SBTW] ("Under the provincial energy regulator, oilsands operators are currently expected to produce the entirety of their assets regardless of their respective emissions intensity—essentially a 'no bitumen left behind' policy. But by selecting only the lowest emissions assets, a procedure known as 'high grading,' Williams said Suncor's oilsands operations could be between 10 and 20 per cent more efficient.").

195. *See supra* note 193. Note that the carbon externality associated with its own oil extraction is, in economic terms, a much larger issue for public landowners than private landowners. A private landowner's decision whether or not to extract will make a vanishingly small contribution to climate change and the individual landowner will experience only a tiny fraction of the harm from climate change. This may require a moral calculation, but in economic terms it does not compare to the value of the oil extracted. The calculation is far different for regulators representing economic and energy powerhouses that can significantly lower greenhouse gas emissions and will capture much of the benefit from lower emissions. *Cf.* James W. Coleman, *Unilateral Climate Regulation*, 38 HARV. ENVTL. L. REV. 87, 92–93

In a parallel development, several jurisdictions are transitioning their oil and gas regulators to a dual focus on environmental and resource revenue goals. For example, the governor and majority leaders of Colorado recently proposed a major overhaul of the state's oil and gas commission.[196] The proposed bill, which was enacted in April of 2019, broadens the focus of the commission from simply fostering the oil and gas industry to also protecting health, safety, wildlife, and the environment.[197] Similarly, there is currently a movement among scholars and environmental groups to ensure that U.S. oil and gas concessions balance the monetary benefits of extraction with the externalities caused by burning fossil fuels.[198] As more oil and gas producing jurisdictions consider adopting climate regulations, they will have to consider how their government's interest in protecting the value of their hydrocarbons should be balanced with their climate goals.

Finally, even in countries that have not yet adopted laws to implement their climate commitments, investors and other stakeholders are increasingly asking companies how they will reconcile their investment in extraction with the new policies that are implied by nations' climate commitments.[199]

C. Perfecting the Concession and the Lease

In this new age of oil and gas law, both private and public landowners are perfecting the legal instruments they use to extract maximum value from their oil and gas resources. Public landowners are adopting hybrid systems that incorporate some of the best aspects of the traditional concession and profit-sharing agreements. These more sophisticated agreements are also being optimized for oil prospects that are most likely to be produced by fracking. And the historical pattern of countries adapting agreements originally made for private landowners has begun to reverse: private landowners are now learning from the innovative agreements developed by public landowners. Private landowners still have catching up to do and could learn from the most recent innovations of public landowners to earn more from their oil and gas prospects.

(2014) (explaining why large jurisdictions such as China and the United States have far more incentive to regulate carbon than small jurisdictions).

196. Judith Kohler, *Colorado Lawmakers Release Comprehensive Oil and Gas Bill, Setting Stage for Potentially Heated Debate*, DENVER POST (Mar. 2, 2019), https://www.denverpost.com/2019/03/02/colorado-lawmakers-release-oil-gas-bill/ [https://perma.cc/9FDG-HPTR].

197. S.B. 19-181, 72d Gen. Assemb., Reg. Sess. (Colo. 2019).

198. Jayni Foley Hein, *Federal Lands and Fossil Fuels: Maximizing Social Welfare in Federal Energy Leasing*, 42 HARV. ENVTL. L. REV. 1, 18–23 (2018). This approach has begun to have success in the courts—a recent decision struck down a United States Bureau of Land Management leasing plan for failing to consider the climate consequences of extracting oil and gas. Wildearth Guardians v. Zinke, 368 F. Supp.3d 41, 41 (D.D.C. 2019).

199. Fenner L. Stewart, *Dominium and The Empire of Laws*, 36 WINDSOR YEARBOOK ACC. JUST. 36 (2019) (showing how the corporate social responsibility is pushing companies to address climate change); Fenner L. Stewart & Anthony G. Cioni, *Holistic Security Risk Management Strategies for E&Ps: Optimizing Performance by Reducing Surface Risk,* 11 J. WORLD ENERGY L. & BUS. 48, 65–71 (2018).

1. New Public Landowner Agreements

The best example of new innovative public agreements comes from Alberta's 2015–16 Royalty Review.[200] Before the review, Alberta had a typical concession system with a few adaptations that had been added over time.[201] This typical concession had oil companies pay set royalties on oil and gas and compete for concessions by bidding more or less bonus in open auctions.[202] Over time, the province had made some modifications designed to encourage continued production during bad times and take a larger share during good times. For example, Alberta used separate royalties on oil and natural gas that were each set by sliding scales that depended on current prices for each commodity.[203] The province had also added some provisions designed to allow production from particularly expensive wells such as wells drilled to frack shale formations. In particular, Alberta allowed a lower 5% initial royalty rate on wells drilled beyond a certain total length, including both the vertical and horizontal section.[204] Each of these kludges could be seen as efforts to mimic some of the benefits of a net-profits system—raising the royalty rate when oil and gas prices were high to share in some of the benefit of bonanza wells and lowering the royalty rate when oil and gas prices were low, or the cost of extraction was high, to ensure that marginal wells were still developed.[205]

The Royalty Review attempted to rationalize this scattered system while addressing the changes wrought by the new prominence of fracking.[206] First, because fracking tends to produce a mix of both gas and oil hydrocarbons, the Review recommended a single system for all hydrocarbons.[207] The previous system set separate royalty rates for gas, natural gas liquids, and oil, which varied based on the price of each commodity and the volume produced.[208] These separate systems created problems when companies feared that a well, profitable on the assumption that the gas royalty rates would apply, would be unprofitable if the company struck oil instead, given the different rates applicable to that commodity.[209] The new royalty set a single standard based on the amount of money, in hydrocarbons, pulled out of the well.[210] For a given amount of dollars in hydrocarbons pulled from the well—whether natural gas, natural gas liquids, or oil—the royalty rate would be set at a certain price: the more valuable the total volume of hydrocarbons pulled out of the well, the higher the royalty rate.[211]

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200. The author was employed as an expert to conduct this review for the province of Alberta, but this paper does not contain non-public information concerning that review.

201. ALBERTA ROYALTY REVIEW, ALBERTA AT A CROSSROADS: ROYALTY REVIEW ADVISORY PANEL REPORT 5–6 (2015).

202. *See supra* notes 96–98 and accompanying text.

203. *Id.* at 22.

204. *Id.* at 62.

205. *See supra* Section III.B.

206. ALBERTA ROYALTY REVIEW, *supra* note 201, at 36.

207. *Id.* at 62.

208. *Id.*

209. *Id.* at 58.

210. *Id.* at 62.

211. *Id.*

Second, because fracked wells cost more, the new royalty system provided a way for oil companies to recover the cost of the well: the oil company would pay a lower, 5% royalty until it had received the average cost of a well in hydrocarbons from its completed prospect.[212] This average "drilling and completion cost" allowance is calculated to cover the average cost of drilling and completing a well in the specific formation where the producer is operating.[213] Thus, a shallow formation that is produced by a simple conventional vertical well will likely have a low average cost, whereas a deep formation that can only be produced through a long well and extensive fracking will generally have a substantially higher average cost.[214] The allowance ensures that when a well produces oil, producers will pay the minimal 5% royalty until they have recovered the average cost of a well in that formation—so a company can be relatively certain of earning its investment back if its well hits oil.[215]

This provision has most of the advantages of a net profit interest: by allowing companies to recover the cost of an average well, it ensures that even marginal prospects will be drilled, realizing some benefit for the government from prospects that would be sterilized by a standard royalty system. And, also like a net profits interest, it ensures that bonanza wells award the landowner a larger share of the wells' net profit because the royalty rate increases dramatically after a well has paid back its cost.

At the same time, the drilling and completion cost allowance avoids the two principal downsides of a net profit system. It does not require the landowner, Alberta, to account for the cost of drilling an individual well by an individual company; instead, Alberta simply uses the average industry-wide cost of drilling a well.[216] As a result, the allowance also fully preserves the incentive for oil companies to keep their costs down. If a company spends less than the average company, it keeps the full benefit because it still gets the 5% royalty rate until the average cost of a well is recovered.[217] Conversely, if a company spends more than average, it pays the excess and the government is not forced to sort out these high cost wells to determine whether the company was merely unlucky or undisciplined in its spending, or worse, was padding its expenses.

Alberta is not the only jurisdiction to move to a more sophisticated system for extracting value from its oil and gas resources. Mexico has also moved to a hybrid system that allows the country to benefit from a mix of royalty and net profit payments through a unique production sharing contract system.[218] Just in 2014 and 2015, over twenty jurisdictions across the world were looking to modify the fiscal

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212. *Id.* at 58–59.
213. *Id.* at 86–87.
214. *Id.* at 84–85.
215. *Id.* at 61.
216. *Id.* at 11.
217. *Id.* at 58.
218. WILSON CTR. MEX. INST., MEXICO'S NEW ENERGY REFORM 44–45 (2018), https://scholarship.law.tamu.edu/cgi/viewcontent.cgi?article=2224&context=facscholar [https://perma.cc/A2MG-4WWV]; AKIN GUMP STRAUSS HAUER & FELD LLP, MEXICO'S ENERGY INDUSTRY ROUND 2.4: MEXICO'S DEEP WATER SUCCESS (2018), https://www.akingump.com/images/content/6/4/v2/64429/Client-Alert-2.1.18-Final-Version.pdf [https://perma.cc/JS54-X43X].

terms of their host country agreements including energy powerhouses like Russia, Iran, Nigeria, and China.[219] As fracking increases oil and gas production around the globe, countries will no doubt move to revise their royalty systems to adopt some of these innovative provisions.

2. New Leasing Practices

In the third age of oil and gas law, innovations in resource owner legal protections have begun to flow back from public owners in the developing world to private landowners in the United States. U.S. landowners have begun to realize that, like countries, they can write leases that provide them a bigger share of the oil and gas from very profitable wells without scaring oil companies away from marginal wells. But landowners can and should go further to incorporate the lessons of modern hybrid royalty systems that capture more of the upside of bonanza wells.

Sophisticated private landowners have begun to adopt some of the innovations developed by public landowners.[220] For example, some private landowners have also begun to require shorter primary terms and higher royalties.[221] Some landowners have even followed countries in placing limits on the secondary term, dictating that even a producing well cannot extend a lease forever unless the oil company pays a minimum royalty.[222]

Landowners should go further to incorporate the lessons of advanced systems like that adopted by Alberta. For one thing, like Alberta, they could use royalties that increase once an oil and gas company has received a set amount of value out of a well. Even if this amount does not exactly equal the average cost of drilling a well, this structure assures the oil company that the royalty will not rise unless it has taken a substantial amount of money out of the well. In some ways, this practice extends the older idea of a "production payment," which is a set sum that will only be paid out of production—that is, money that will be paid if the well is successful but will not be paid on a dry well.[223]

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219. ALBERTA ROYALTY REVIEW, *supra* note 201, at 112; *see also Petrobras CEO Questions PSC Contract Model*, ARGUS MEDIA (Aug. 20, 2019), https://www.argusmedia.com/en/news/1962578-petrobras-ceo-questions-psc-contract-model [https://perma.cc/3X7V-924V] (describing potential revisions to Brazil's host government agreement system).

220. *See* Pierce, *supra* note 50, at 478–79 (describing these alternative legal agreements).

221. Nicholas Miller, *Negotiating an Oil and Gas Lease*, http://aglaw.libsyn.com/episode-33-nicholas-miller-negotiating-an-oil-and-gas-lease [https://perma.cc/LF27-2L4W] (stating that the standard was once a 1/8 royalty and five-to-ten-year primary term, but the standard now is a 1/4 royalty with three-year primary term).

222. JUDON FAMBROUGH, HINTS ON NEGOTIATING AN OIL AND GAS LEASE, REAL EST. CENT. (1997), http://counties.agrilife.org/lasalle/files/2011/03/negotiating_oil_gas_lease.pdf [https://perma.cc/9CSL-ERMK]. Landowners should likely go further and, like countries, adopt a fixed term of years that limits the secondary term of a lease, even if it is producing oil and gas.

223. Robert E. Hardwicke, *The Purchase of Producing Oil or Gas Properties by Use of a Production Payment*, 33 TEX. L. REV. 848, 848-49 (1955) (explaining the purpose and practice of production payments).

Scholars have long noted that net profits would better align the incentives of oil and gas companies with landowners and suggested that more landowners should include a net-profits interest in their leases.[224] But they have cautioned that this solution will not be practical unless drafters can devise an instrument that surmounts the practical difficulty of forcing landowners to audit expenses of an oil and gas company to determine its net profits on a well.[225] Alberta has provided a rough-and-ready solution: simply allow the company to recover a negotiated and fixed value of oil and gas out of the well that will approximate its costs and then take a much larger share of the subsequent oil.

Second, like Alberta, landowners should adopt a unified system for oil and gas royalties. Separate oil and gas clauses made some sense when development typically targeted one or the other mineral. In the early years of oil production, natural gas was often considered little better than a nuisance because it could be prohibitively expensive to transport it to a market where it could be sold; early leases sometimes offered landowners a mere yearly fee for a gas well rather than a royalty share.[226] Natural gas liquids, when present, were often governed by a separately negotiated clause that could be even more complex.[227] But fracking unlocks mixed oil and gas molecules trapped in the source rock, so a lease that contemplates fracking should have a royalty clause that works well for whatever mix of crude oil, natural gas liquids, and gases are found in the ground.[228] Alberta has found a unified solution that will also be much simpler for private landowners: the more valuable the hydrocarbons out of the well—whether gas, or natural gas liquids, or oil—the larger share paid by the oil company.[229] Landowners can rely on these legal innovations to ensure they receive full benefit from the unprecedented oil and gas boom sweeping the nation.

CONCLUSION

History's biggest oil boom is happening now in the United States and ushering in the third age of oil and gas law. Like the two previous ages, this new age brings with it revolutionary private and public law instruments to manage this new wealth. New lease agreements and new concession systems are ensuring that private and public landowners receive the full benefit of their oil and gas. Old conservation laws are being modified to address new technologies like directional drilling and hydraulic fracturing. And public landowners must now reconcile their climate regulation with

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224. Pierce, *supra* note 50, at 475–76.

225. *Id.* at 476–77; *cf.* Goldberg, *supra* note 64, at 528–29 (showing how Hollywood companies manipulate "net profits" calculations to limit compensation to creative artists).

226. Hardwicke, Jr., *supra* note 65, at 791.

227. *Id.* at 794–95.

228. This would also avoid problems like shut-in clauses that do not allow shut-in of a well that produces mostly gas and just some oil. Nancy J. Forbis, *The Shut-in Royalty Clause: Balancing the Interests of Lessors and Lessees*, 67 TEX. L. REV. 1129 (1989). Under such a lease, the oil and gas company may be forced to produce the small amount of oil and flare a large amount of gas that could, in time, provide the primary economic benefit from the well.

229. ALBERTA ROYALTY REVIEW, *supra* note 201, at 57 (describing how to "[h]armonize the royalty structures across crude oil, liquids and natural gas").

their concessions' systems focus on encouraging rapid production of oil and gas. A new age of oil and gas law has dawned and a new generation of oil and gas lawyers must arise to meet its challenges.